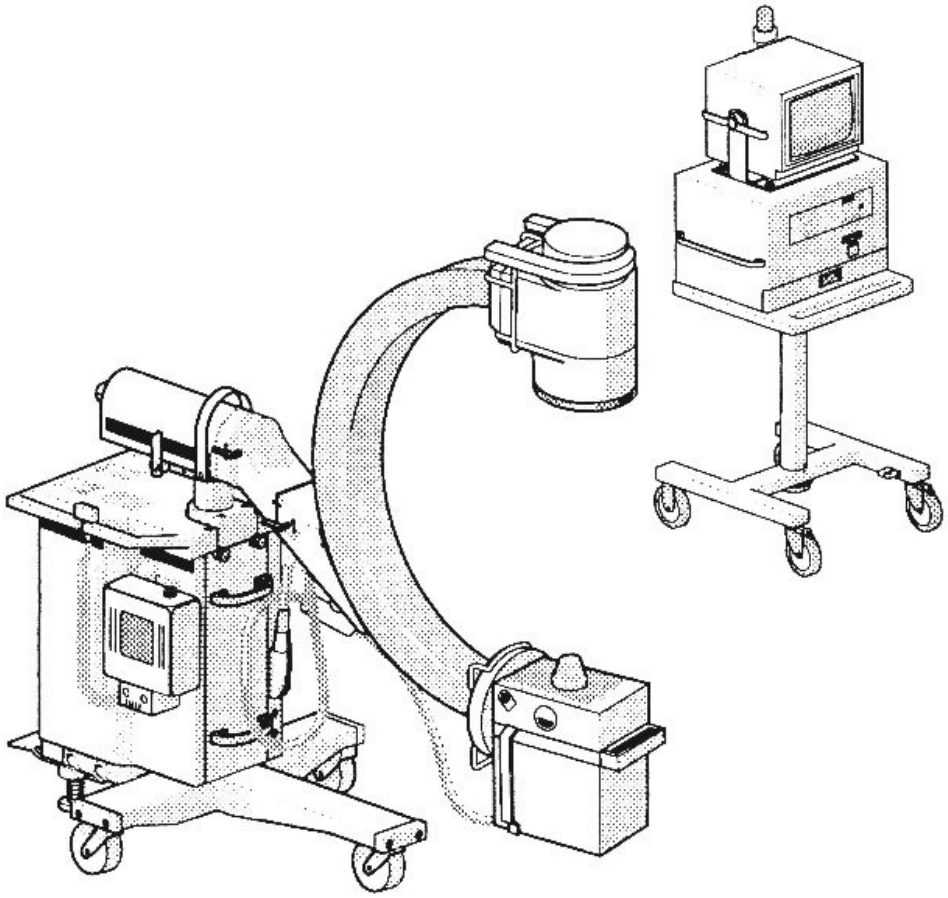
OPERATIONMANUAL



Philips BV 25 T

Contents

Part 1	**Introduction**	**1**
1.1	**General specifications**	**2**
1.1.1.	Designation of the equipment	2
1.1.2	Total view	2
1.1.3	Intended use	3
1.2	**Technical data**	**4**
1.2.1	Mechanical data	4
1.2.1.1	Dimensions and weighs of the individual containers	4
1.2.1.2	Manoeuvrability of C - arm	4
1.2..1.3	Manoeuvrability of the system	4
1.2.2	Performance data	5
1.2.2.1	X-ray source	5
1.2.2.2	Display - unit	5
1.2.2.3	Bit map memory unit	5
1.2.2.4	Floppy disk data format	6
1.2.2.5	Collimator	6
1.2.3	Power supply	6
1.2.4	Environment conditions	6
1.2.4.1	Environment conditions for operation	6
1.2.4.2	Environment conditions for storage	7
1.2.5	Diagram cooling X-ray tube	7
1.2.6	Diagram **A**utomatic **D**ose rate **R**egulation	8
1.2.7	Diagram Scattered ray intensities on use water phantoms 24 x 25 x 20 cm	8
1.2.8	Diagram Scattered ray intensities on use water phantoms with 12 cm diameter	9
1.3	**Technical description**	**10**
1.3.1	Arrangement of the X-ray system	10
1.3.2	Description of the individual assembly groups	11
1.4	**X – ray system**	**16**
1.4.1	X - ray unit	16
1.4.2	Display unit	17
1.4.3	Accessories	18
1.4.4	Contents of the individual containers	19
1.4.4.1	Container 1/8	19
1.4.4.2	Container 2/8	20
1.4.4.3	Container 3/8	21
1.4.4.4	Container 4/8	22
1.4.4.5	Container 5/8	23
1.4.4.6	Container 6/8	24
1.4.4.7	Container 7/8	25
1.4.4.8	Container 8/8	26

Part 2 Operation and Maintenance 27

2.0 Junction points sub assemblies 28

2.1 Building the X – ray system 29

2.1.1 Demands on the building place 29
2.1.2 Preparations for the building up 29

2.1.2.1 Marking of the junction points 29
2.1.2.2 Position of the integrated red lock buttons 30
2.1.2.3 Visual inspection during the assembly 30

2.1.3 Assemble the X - ray unit 31
2.1.4 Assemble the Display unit 41

2.2 Connection of the devices 45

2.2.1 Connection X -ray unit and display unit 45
2.2.2 Emergency operation 46
2.2.3 Connection with independent operation of the display unit (without X - ray unit) 46

2.3 Explanation of the individual control elements 47

2.3.1 Mechanical blocking/adjustment elements of the X - ray unit 47
2.3.2 Push buttons of the X - ray unit 49
2.3.3 Control elements collimator 58
2.3.4 Exposure modes 58

2.3.4.1 Exposure by hand switch 58
2.3.4.2 Exposure by double foot switch 58

2.3.5 Mechanical control elements of display unit 59
2.3.6 Switch/push button of bit map memory unit 59
2.3.7 Tester for fuses 62
2.3.8 Connectors bit map memory unit 62
2.3.9 Switch/push button of display unit 62
2.3.10 Connectors display unit 63

2.4 System checks 64

2.4.1 Visual inspection before use 64
2.4.2 Mechanical system check 65
2.4.3 Electrical system check 67
2.4.3.1 Electrical system check Display unit 67
2.4.3.2 Electrical system check Electronic unit 69
2.4.4 Electrical system check with generating of X-ray's 72
2.4.4.1 Function test of the automatic dose rate regulation 72
2.4.4.2 Function test of the imaging in the individual kinds of fluoroscopy 74

2.5 Burn in the x-ray tube (gettering) 78

2.6 System check after short work breaks 80

2.7 Operation of the X – ray unit 81

2.7.1 Attachment of the sterile cloth covers 81

2.7.2 Operation bit map memory unit 83

2.7.2.1 Handling of floppy disks 83
2.7.2.2 Protection of floppy disks 83
2.7.2.3 Inscription of floppy disks 83

2.7.2.4 Formatting floppy disk 84
2.7.2.5 Store a picture on the floppy disk 85
2.7.2.6 Read a picture from the floppy disk 86

2.7.3 Fluoroscopy 87

2.7.3.1 Introduction 87
2.7.3.2 Single pulse (snapshot) 87
2.7.3.3 Single pulse (snapshot) with manual settings 88
2.7.3.4 Fluoroscopy with automatic settings and pulsed fluoroscopy with automatic settings 89
2.7.3.5 Fluoroscopy with manual settings and pulsed fluoroscopy with manual settings 90
2.7.3.6 Fluoroscopy with subtraction 91

2.7.4 Radiography mode 93

2.7.4.1 Kinds of radiography 93
2.7.4.2 Pre-setting and work routine 93
2.7.4.3 Cartridge holder installing 94
2.7.4.4 Operation of the Cartridge holder 94
2.7.4.5 Rotation of the X-ray source 95
2.7.4.6 Collimator/tubus installation 95
2.7.4.7 Collimator operation 96
2.7.4.8 Exposure with fixed parameter 97
2.7.4.9 Exposition table 99
2.7.4.10 Exposure with variable parameter (free data) 100
2.7.4.11 Radiography with manual setting 102
2.7.4.12 Adjusting examples of radiography mode at the outside of the c-arm 103
2.7.4.13 Adjusting examples of radiography mode (dental) 104
2.7.4.14 Radiography mode dental 105

2.8 Putting out of operation 106

2.9 Disassembling to the transportation/dispatch 106

2.9.1 Preparations to the dismantle 106
2.9.2 Dismantling and packing of the X - ray unit and the display unit 106
2.9.2.1 Container 8/8 106
2.9.2.2 Container 7/8 107
2.9.2.3 Container 6/8 107
2.9.2.4 Container 5/8 107
2.9.2.5 Container 4/8 108
2.9.2.6 Container 3/8 109
2.9.2.7 Container 2/8 110
2.9.2.8 Container 1/8 110

2.10 Operation and working under special climatic or other conditions 111

2.11 Operation with a generator aggregate 111

2.12 Servicing, maintenance, period work, troubleshooting and repair 112

2.12.1 Introduction 112
2.12.2 Time table for periodic work 113

2.12.2.1 Period work on the “X – ray equipment into use" 113
2.12.2.2 Period work on the "stored equipment" 129

2.12.3 Description of the maintenance work 144

2.12.3.1 Cleaning 144
2.12.3.2 Disinfection 144

2.13 Trouble, error, reason and repairing 145

2.13.1 Introduction 145
2.13.1.1 Lamp test 145
2.13.1.2 Fuse test/change 146
2.13.1.3 LED in mains control 146
2.13.1.4 Fuses of the bit map memory unit 146
2.13.1.5 Fuse tester check (bit map memory unit) 147

2.13.2 Listing of the troubles after switching on (fluoroscopy) 147
2.13.3 Listing of the troubles diskette/bit map memory unit 149
2.13.4 Listing of the troubles on fluoroscopy 150
2.13.5 Listing of the troubles on operation with the cartridge holder 153
2.13.6 Listing of the troubles on operation with collimator 155
2.13.7 Listing of the troubles on operation with dentaltubus 156

2.14 Preservation and packing, storage 157

2.14.1 Storage 157

2.15 Transportation, transportation/dispatch 157

2.15.1 Transport with a truck 157
2.15.2 Transport with a airplane 159

2.16 Technical safety and operational safety regulations 158

2.16.1 Safety-relevant checks 158
2.16.1.1 Protective grounding connection 158
2.16.1.2 Insulation resistance. 158
2.16.1.3 Tension strain 158
2.16.1.4 Arrester discharge current 158
2.16.2 Employment of the equipment in stationary medical rooms 158
2.16.3 Employment of the equipment under emergency-moderate conditions 159
2.16.4 Special regulations 159
2.16.5 Explosion prevention 159
2.16.6 Electrical safety 159
2.16.7 Potential equalization 160
2.16.8 Radiation protection areas 161
2.16.8.1 Operational monitored area 161
2.16.8.2 Controlled area 161
2.16.8.3 Vocational persons exposed to radiation 162
2.16.8.4 Tables for the calculation of the body doses 163

2.17 Constance Check 164

Part 3 Trouble shooting 165

3.1 Error listing with troubleshooting hints 166

3.2 General repair procedure 181

3.2.1.1 Behaviour with assembly works 181
3.2.1.2 Ground connection 181
3.2.2 Cables, connectors and equipment plug sockets check and clean 181
3.2.3 Corrosion /coat of paint 182

3.2.4 Chassis 183

3.2.4.1 Wheel change 183
3.2.4.2 Guide plate changes 183
3.2.4.3 Guidance wave change 183
3.2.4.4 Kick strip plate change 184
3.2.4.5 Rubber plating of brake pedal change 184
3.2.4.6 Tension spring / wire rope change 184
3.2.4.7 Barrier for stroke column change 185
3.2.4.8 Absorption buffers at the brake lever change 185
3.2.4.9 Unblocking mechanism change 186
3.2.4.10 Brake buffers change 186

3.2.5 Stroke column 187

3.2.5.1 Guard plate of the drive belts change 187
3.2.5.2 Protective motor hood completely change 187
3.2.5.3 Engine hand wheel completely or only for knob change 187
3.2.5.4 Covers of the stroke column change 188
3.2.5.5 Handle change 188
3.2.5.6 Drive belts change 189
3.2.5.7 V-belt tension adjust 189

3.2.6 Electronics block 190

3.2.6.1 Covers change 190
3.2.6.2 Kick strip plate change 190
3.2.6.3 Bolting device of the collimator change 191
3.2.6.4 Cable support change 191
3.2.6.5 Mains cable change 191
3.2.6.6 Cable attachment change 192
3.2.6.7 Hand switch change 192
3.2.6.8 Control panel change 192
3.2.6.9 Individual PCB change 192

3.2.7 C-arm bracket 193

3.2.7.1 Carrier handle change 193
3.2.7.2 Grip of the brake of the horizontal movement change 193
3.2.7.3 Grip of the brake for rotating motion change 193
3.2.7.4 Covers change 193
3.2.7.5 Locking levers change 194
3.2.7.6 Protection socket change 194
3.2.7.7 Unlocking button for barrier change 195

3.2.7.8 Brake for rotating motion adjust 195
3.2.7.9 Brake for rotating motion change 195
3.2.7.10 Bellows at the C-arm change 196
3.2.7.11 Brake for horizontal movement change 196
3.2.7.12 Camps in the clevis mounting change 196
3.2.7.13 Camps in the clevis mounting adjust 196

3.2.8 C-arm 197

3.2.8.1 Handle change 197
3.2.8.2 Transportation barrier change 197
3.2.8.3 Cover change 197
3.2.8.4 Locking levers with axle change 197
3.2.8.5 Cable entry completely change 198
3.2.8.6 Cable suspension change 198
3.2.8.7 Safety lock pin for cable suspension change 198
3.2.8.8 Push button for sterilizable cover of the c-arm change 198
3.2.8.9 Brake for C-arm-shift adjust 199
3.2.8.10 Rubber buffers of the brake for C-arm-shift change 199

3.2.9 Image intensifier unit 200

3.2.9.1 Camera cover change 200
3.2.9.2 Raster change 200
3.2.9.3 High voltage plugs take new grease 200

3.2.10 Collimator 201

3.2.10.1 Knob change 201
3.2.10.2 Clutch plate change 201
3.2.10.3 Halogen bulb change 201

3.2.11 Trolley 202

3.2.11.1 Wheels change 202
3.2.11.2 Attachment knobs change 202

3.2.12 Bit map memory unit 203

3.2.12.1 Bit map memory unit opening 203
3.2.12.2 Handle bit map memory unit change 203
3.2.12.3 Individual PCB change 203

3.2.13 Display unit 204

3.2.13.1 Carrying handle change 204
3.2.13.2 Friction washers change 204
3.2.13.3 Rotary knob/buffers of the hang up mounting change 204
3.2.13.4 Lamp in power switch change 205
3.2.13.5 Lamp in radiation indicator change 205
3.2.13.6 Fuse change 205
3.2.13.7 Toggle switch check 205

3.3 System description 206

3.3.1 X - ray unit 206

3.3.1.1 Electronics block 206
3.3.1.2 C-arm with cable 206
3.3.1.3 Image intensifier unit 207
3.3.1.4 X-ray head 207
3.3.1.5 Collimator 207

3.3.2 Display unit 207

3.3.2.1 Trolley 207
3.3.2.2 Bit map memory unit 207
3.3.2.3 Display unit 207

3.4 Error messages 208

3.4.1 Not-ready conditions 208
3.4.2 Alarm conditions 209

3.5 Installation overview 210

3.5.1 Electronics block 210

3.5.1.1 Electronics block control console 210
3.5.1.2 Electronics block WA unit 211
3.5.1.3 Electronics block door front side 212
3.5.1.4 Electronics block door rear side 213
3.5.1.5 Electronics block framework right 214

3.5.2 Bit map memory unit 215

3.5.2.1 Bit map memories front 215
3.5.2.2 Bit map memories inside 216

3.5.3 Display unit 217

Part 4 Appendices 218

Append. A Chassis
Append. B Stroke column
Append. C C – arm bracket
Append. D C – arm bracket detail
Append. E C – arm
Append. F Electronic block detail a
Append. G Electronic block detail b
Append. H Electronic block rack
Append. I Bit map unit detail
Append. K Bit map unit electronic rack
Append. L Display unit
Append. M Collimator

PART 1

Introduction

1.1 General specifications

1.1.1 Designation of the equipment

X - RAY EQUIPMENT MEDICAL in 8 containers

Manufacturer : Philips Medicine Systems GmbH
Röntgenstr. 24
22331 Hamburg

1.1.2 Total view

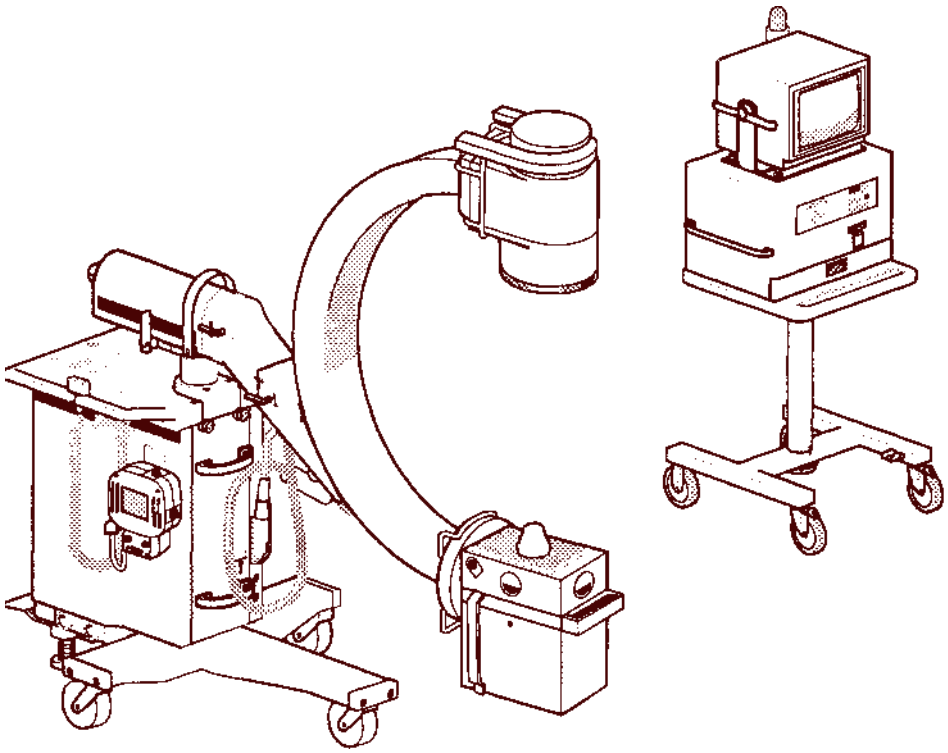


Fig. 1 X – Ray Unit (assembled for fluoroscopy operation)

1.1.3 Intended purpose

The BV 25 T system is a mobile, detachable and in 8 containers packed X - Ray system for

- Flouroscopy with TV and digital storing on floppy disk
- Radiography with cassette holder (mounted at the image intensifier)
- Dental pictures
- Cartridge exposures with collimator
- Analysis of floppy disks (independent operating of the display unit is possible)

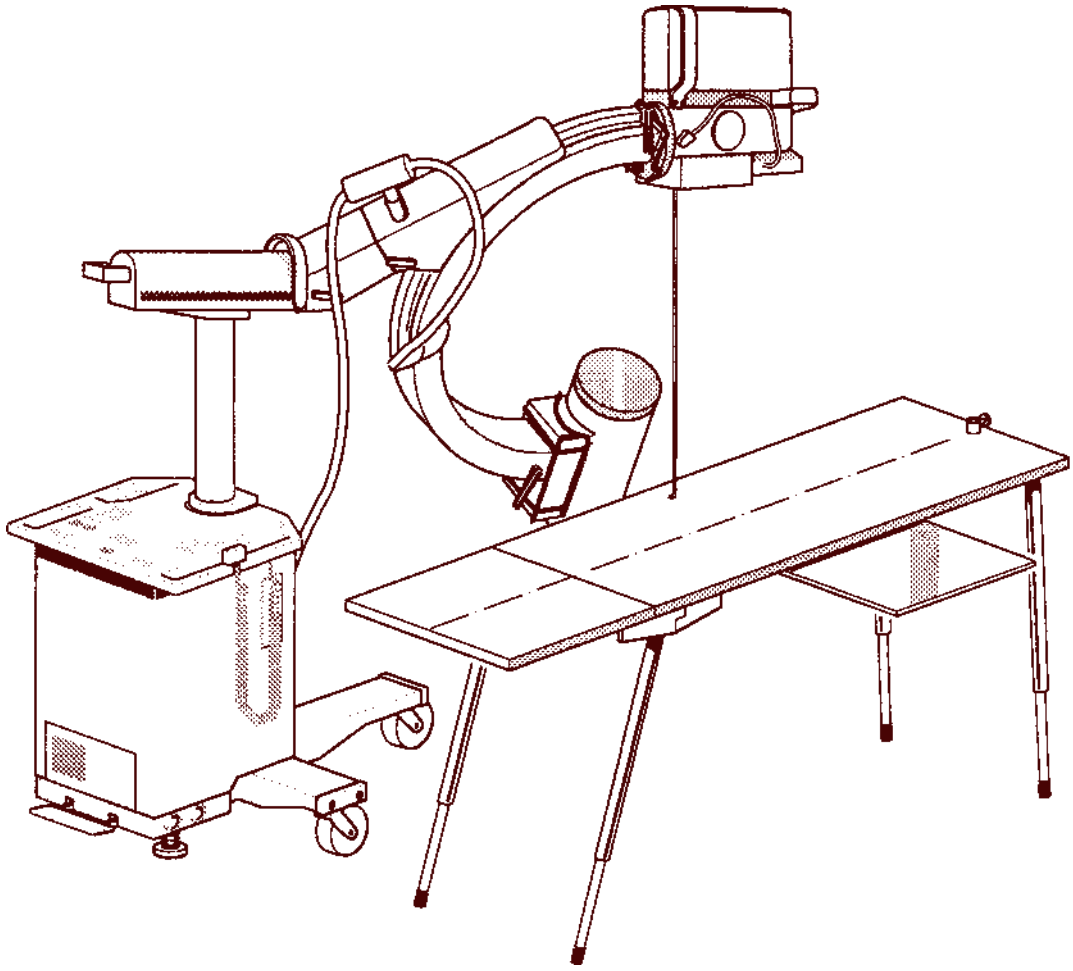


Fig. 2 X-ray system (assembled for radiography operation at the table)

1.2 Technical data

1.2.1 Mechanical data

1.2.1.1 Dimensions and weighs of the individual containers

Container number	Nominal dimensions- in mm (L x B x H)	Weight in kg full	Weight in kg empty
1/8	1200 x 800 x 250	85	41,3
2/8	800 x 600 x 500	90	30,5
3/8	800 x 600 x 750	125	36,5
4/8	1200 x 800 x 500	110	44,5
5/8	800 x 600 x 500	95	37,1
6/8	800 x 600 x 750	123	45,3
7/8	800 x 600 x 500	86	32,3
8/8	800 x 600 x 750	90	48,5

Total weight of the X - Ray unit: 369 kg

Total weight of the display unit: 121 kg

Total weight completely packed X-ray System: 804 kg

1.2.1.2 Manoeuvrability of the C - arm

Vertical movement of c - arm: 44 cm (to the storage position 50 cm)

Longitudinal movement of c - arm : 17cm

Fan movement of c – arm: ±12,5°

Rotating movement of c - arm: ±154° (to estimate barrier)

Circle movement of c - arm : - 26° bis +89°

1.2.1.3 Manoeuvrability of the system

X – Ray head rotation: ±100 °, in each case 10 steps

Display unit swivel: -18° bis+ 22°

1.2.2 Performance data

1.2.2.1 X-ray source

Certification number:	Bauartzulassung HH 41/82 Rö PTB-Prüfungsschein Nr. 6.58-M 186 vom 31.8.1982
Rated voltage	105kV
Long-term rated output:	60 W
Entrance rated output	Large Focus(Radiography): 2200 W Small Focus (Flouroscopy): 700 W
Kind of anode	Double focus fixed anode
Focal spot :	0,6 und 1,6 mm
Anode material	Tungsten embedded in copper
Setting per stage:	1 kV
Focus film distance (FFA):	90 cm (within the c-bow)
Radiation time:	0,01 - 4,0 s at 20 mA
Kassettenhalter:	suitably for normal and raster cartridges: 18 x 24 cm, 24 x 30 cm and 20 x 40 cm

1.2.2.2 Display unit

Screen diagonal:	51 cm

1.2.2.3 Bit map memory unit

Storage type:	Digital RAM semiconductor memories
Storage capacity:	2 Television frames
Memory array:	1080x600 of pixels
Memory depth:	10bit
Resolution of grey tone:	8 bit - 256 grey tones
Image processing possibilities:	Subtraction Contrast harmonization Real time noise suppression with movement identification Linear picture integration

1.2.2.4 Floppy disk data format

Floppy disk format:	3,5" (8,54 cm), 1.4 MB HD
Storage capacity :	6 television frames (circular area) per floppy disk

1.2.2.5 Collimator

Power supply voltage:	12 V/AC from electronics block
Light Source :	100 W- halogen bulb
Switch-on time:	30s

1.2.3 Power supply

Mains voltage:	220 V/AC
Frequency:	50 / 60 Hz ±1%
Leakage current:	< 100 µA
Connection:	7 m Power cord by Wall connection for complete system powering and 5 m Power cord at Stand alone operation mode of display unit
Automatic power disconnection at 220 V ~:	< 155 VAC ±2% and > 265 VAC ±2% or temperature < 0 °C ±2 °C
Restart (switch on)operation:	> 165 VAC ±2% and < 245 VAC ±2% or temperature > 0 °C ±2 °C
Maximum Current at 220 V:	20 A, securing with 16 A-Fuse slow acting
Maximum Current at 110 V:	35 A, securing with 35 A-Fuse slow acting
Power consumption :	
- Ready state:	1100 W, 6,5 A
- Fluoroscopy:	1550 W, 10,5 A
- Radiography:	4700 W, 26,5 A
- Only display unit:	300 W, 1,3 A

1.2.4 Environment condition

1.2.4.1 Environment condition for Operating

Ambient Temperature during the Operating:	0 °C bis 45 °C
Relative humidity during the operation:	20% to 90% without condensation
Atmospheric pressure:	500 hPa bis 1060 hPa
Acoustic oscillations:	< 45 dB in 1 m distance from System at the frequency range from 300 cps to 16 Kcps
Radio interference:	in accordance with VDE 0875, interference level N
Magnetic interfering radiation:	in accordance with IEC 58A, Abs. 16

1.2.4.2 Environment condition for storage

Storage ambient temperature	+12 °C bis 25 °C
Relative air humidity :	25% to 80% without condensation
Acceleration border for transport:	5 g

1.2.5 Diagram Cooling X – Ray Tube

The Cooling Diagram of the X – Ray Tube it is represented in Fig. 3.

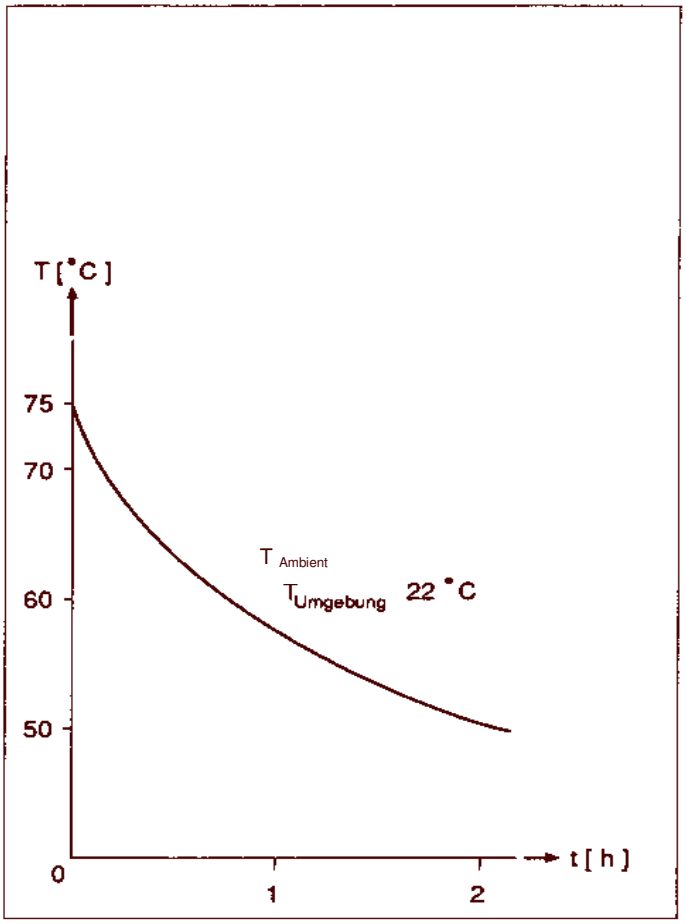


Fig. 3 Cooling Diagram

1.2.6 Diagram Automatic Dose rate Regulation

The automatic dose rate regulation (kV/mA) effected in the same direction for kV and one represents to mA in fig. 4

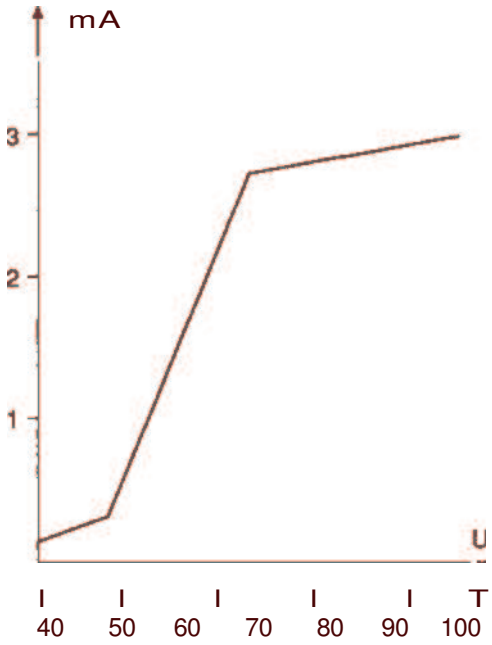


Fig. 4 Automatic dose rate regulation

1.2.7 Diagram Scattered ray intensities on use to water phantoms 24 x 25 x 20 cm

The scattered ray intensity on use water phantoms 24 x 25 x 20 cm is in fig. 5 represented

Setting: 66 kV, 2 mA

Range	Dose rate in µSv/min
1	0,6
2	1,2
3	3,0
4	6,0
5	12,0
6	18,0
7	24,0
8	36,0
9	48,0
10	60,0

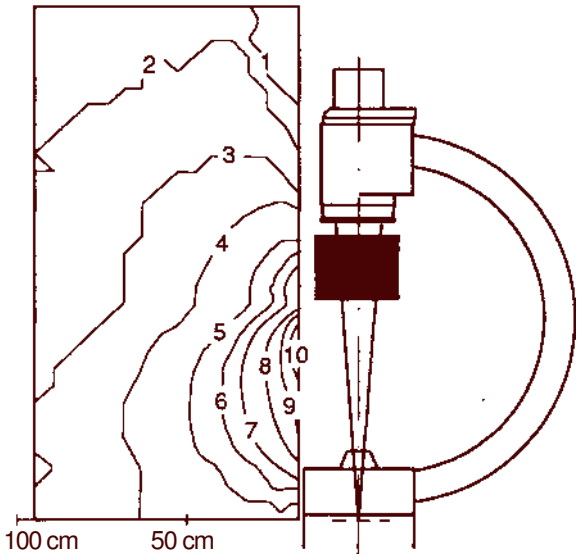


Fig. 5 Scattered ray intensity right parallelepiped

1.2.8 Diagram Scattered ray intensities on use to water phantoms with 12 cm diameter

The scattered ray intensity on use water phantoms with 12 cm diameters is in fig. 6 represented

Setting: 58 kV, 1 mA

Range	Dose rate in µSv/min
1	**0,6**
2	**1,2**
3	**3,0**
4	**6,0**
5	**12,0**
6	**18,0**
7	**24,0**
8	**36,0**
9	**48,0**
10	**60,0**

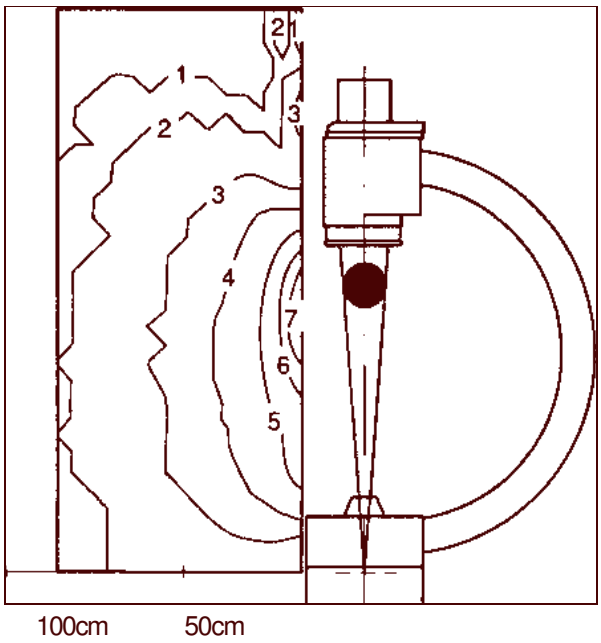


Fig. 6 Scattered ray intensity ball

1.3 Technical description

The X-ray unit is a mobile, detachable and in 8 containers packed X - Ray TV System for Fluoroscopy with documentation on floppy disk and radiographic film recording technology with film and cartridge. The installations of the containers make a simple packing and a safe transport of the x-ray unit.
The X – Ray System is controlled by a microprocessor, which ensures that the instructions entered on the control panel will transfer to the system.
The display unit as well as the image intensifier unit serves with the fluoroscopy for the transformation of the X-rays into a TV picture. Brightness and contrast of the picture are adapted automatically to the environment lighting.

1.3.1 Arrangement of the X - Ray System

The X - Ray System consists of:

X - Ray Unit

Display Unit

Accessories

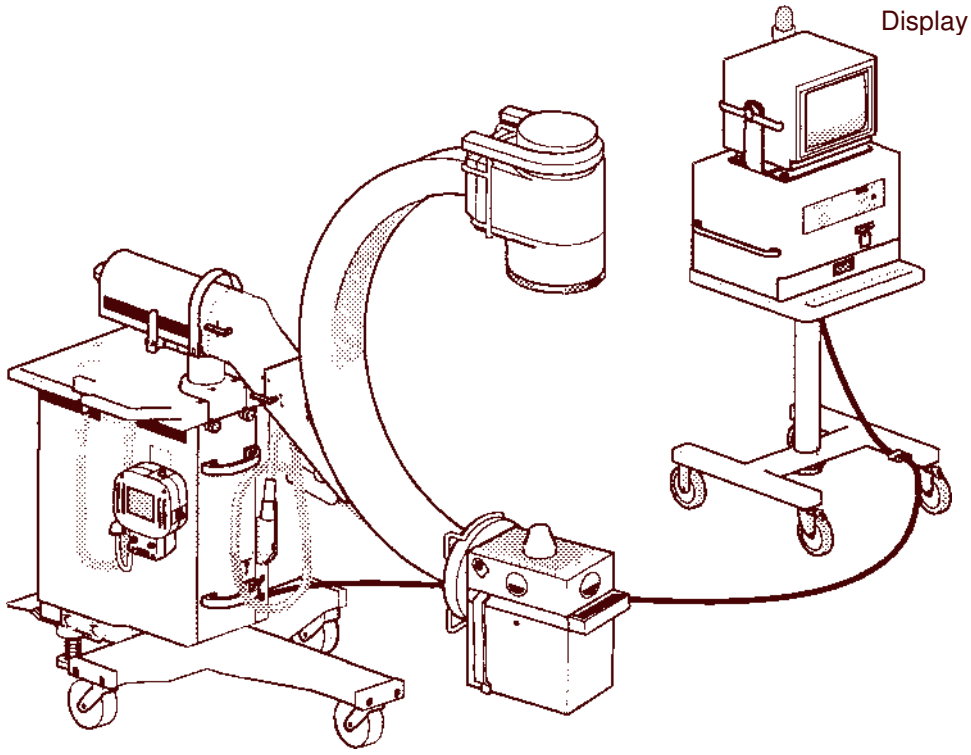


Fig. 7 X - Ray System assembled for Flouroscopy

1.3.2 Description of the individual assembly groups

The chassis (8) is a construction with three tiltable plastic wheels and a foot brake, manufactured from steel.
Onto the chassis the stroke column and the electronics block are installed.

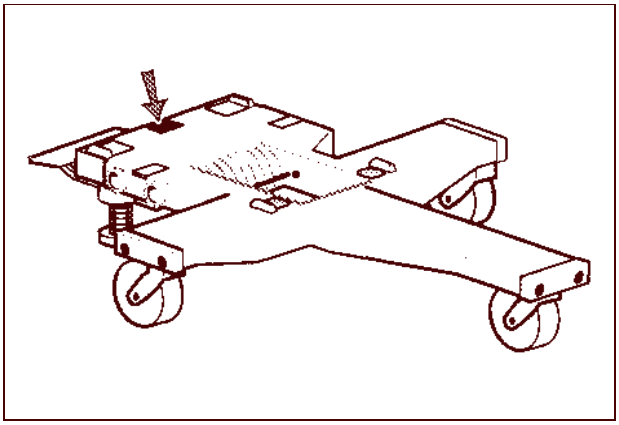


Fig. 8 chassis

The stroke column (9) consists of a lifting cylinder with motor and mechanical drive for the vertical adjustment of the C - arm. Two limit switches limit the lifting range, and an additional switch (9/1) is easily intended for further driving of the stroke column down for the disassembly of the x-ray unit.

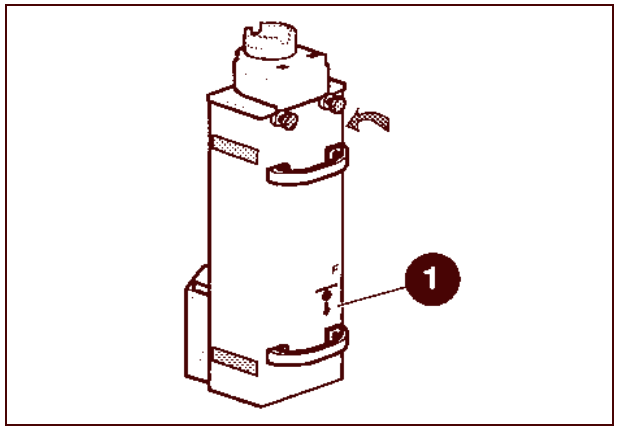


Fig. 9 Stroke column

The electronics block (10) is a totally enclosed metal housing also on the top side installed control panel. It contains the complete control electronics for the execution of the different kinds of flouroscopy/radiography. The control panel on the top side is designed as transparency keyboard and is partitioned into the areas for flouroscopy and radiography.

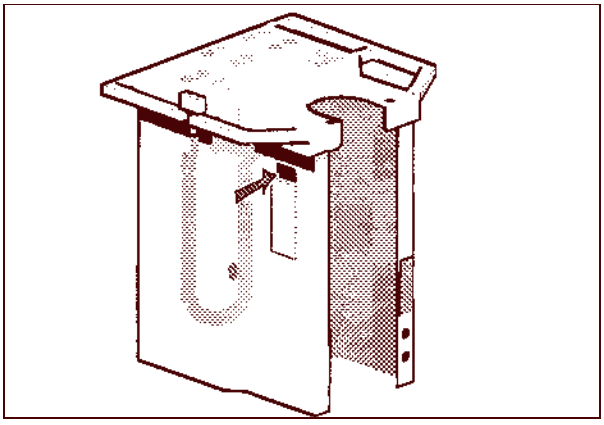


Fig. 10 Electronics block

The C - arm bracket (11) consists of a cylinder for the forward and backward motion of the C - arm and swivel joints for fan and propeller movement.

The brake levers for fan movement (11/3) and propeller movement (11/2) are present on both sides. For locking the forward / backward movement is only one lever (11/1) present.

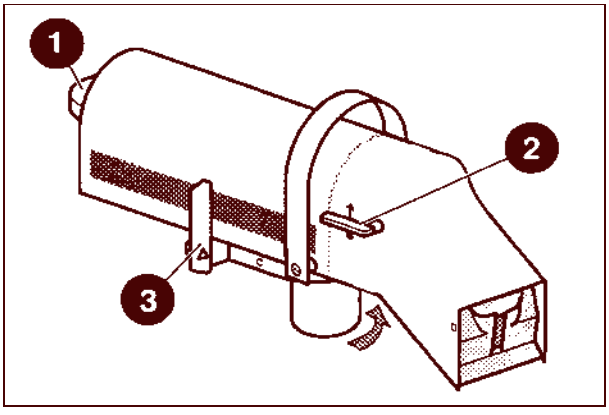


Fig. 11 C – arm bracket

The C-arm (12) consists of a light alloy elbow with integrated cable channel for the fitting and connecting the X-ray source and the image intensifier unit. The brake levers for the circulation (12/1) of the C - arm are present at both sides..

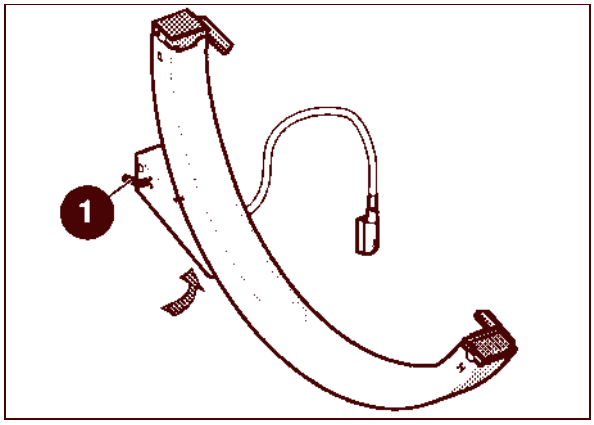


Fig. 12 C - arm

The image amplifier unit (13) contains a image intensifier tube for the transformation of the X-rays into a light sample at the fiberoptics output screen. This light is then converted by a video camera into a video signal. The high voltage needed for the image intensifier tube is produced by a cascade generator.

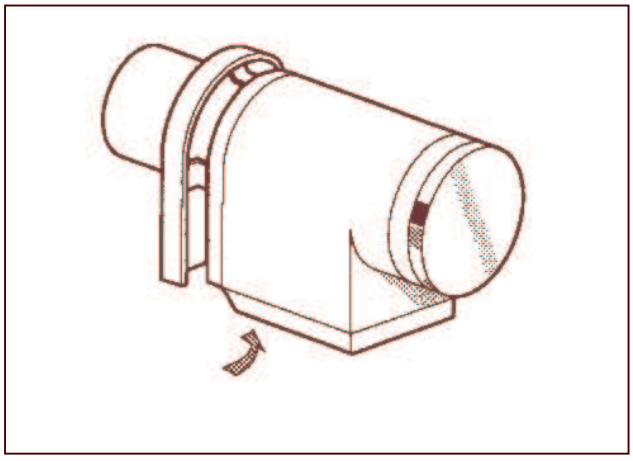


Fig. 13 Image intensifier Unit

The X-ray source (14) is developed in a metal housing and contains an X-ray tube with tungsten/copper double focus fixed anode and double focal spot. The X-ray source contains further an iris screen and half transparent screens. Screens and iris screen are steered via the control panel of the electronics block. The position of the focus is marked by one color point (14/1) on the housing.

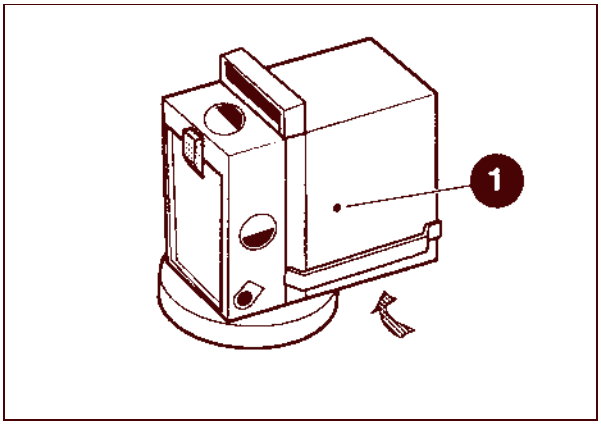


Fig. 14 X-ray source

The basic frame (15) is a structural steelwork with two fixed and two tiltable wheels (15/1), equipped (with brakes), with a mounting device for the desk top carrier

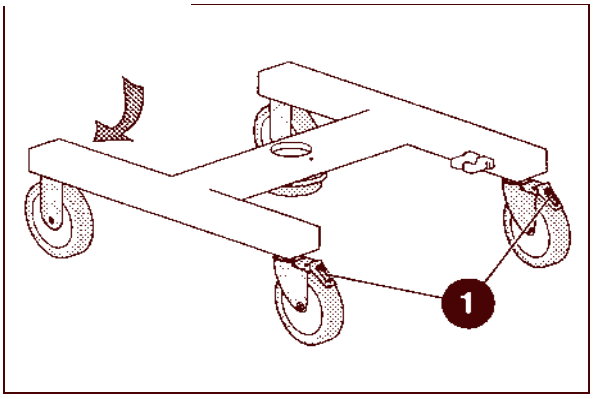


Fig. 15 Basic Frame

The desk top carrier (16) consists of a structural steelwork with grooves for the fast assembly.

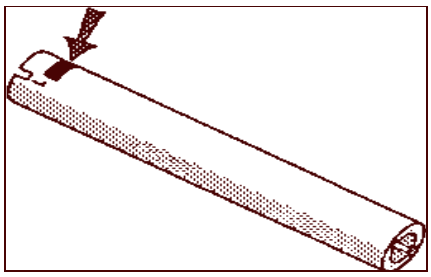


Fig. 16 Desk top carrier

The support plate (17) for the bit map memory unit consists of a structural steelwork and screw connections for the safe assembly of the bit map memory unit as well as the display unit. The front of the support plate is equipped with a grip rail.

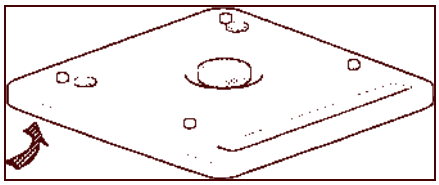


Fig. 17 Support plate for memory unit

The bit map memory unit (18) consists of a metal housing for the installing of the individual electronic modules and memory (maximally 2 TV pictures can be stored in the memory) and a floppy disk drive for 3 1/2", 1,4 MB HD floppy disk. On the front plate the control elements are designed as transparency keyboard. In the lower range a storage drawer (18/1) with metal cover is installed for the keeping of accessories and supply. On the back are the female connectors and a battery-operated fuse tester.

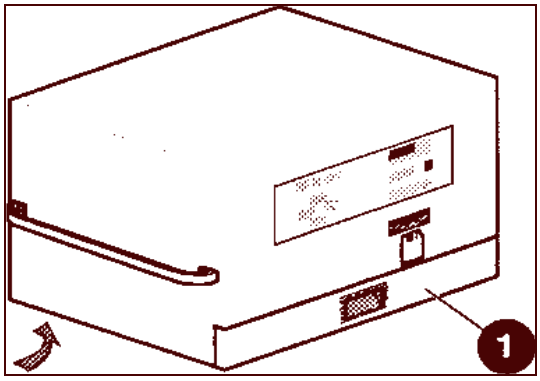


Fig. 18 Bit map memory unit

CAUTION

The drawer flap can cause injuries when falling down. When opening the drawer the handle of the support plate do not touch (clamping danger**)**

The radiation indicator (19) is a signal lamp attached to the bit map memory unit. The radiation indicator shines as soon as x-ray is produced..

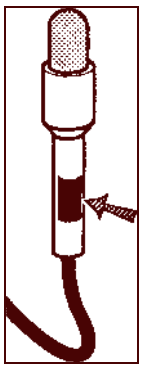


Fig. 19 Radiation indicator

The display unit (20) is tiltable installed on a retaining plate with screw connections (assembly on the bit map memory unit) and serves for the rendition of the pictures. Brightness and contrast of the display unit are adapted automatically to the environment lighting and can be adjusted over the control panels at the bit map memory unit or/and at the electronics block

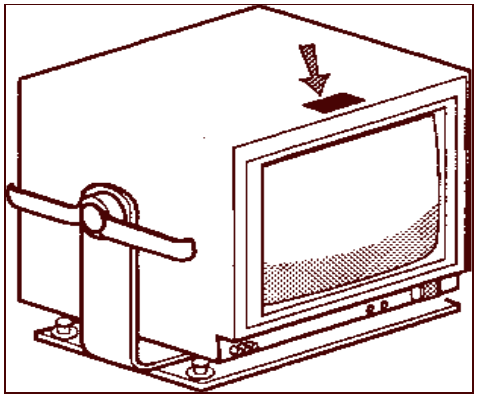


Fig. 20 Display unit

The collimator (21) is installed at the right side of the electronics block and touched down if necessary on the emitter. Adjustable plates of Pb are for adjustment the screen window and a lockable tape measure equipped with a source of light for the representation of the x-ray.

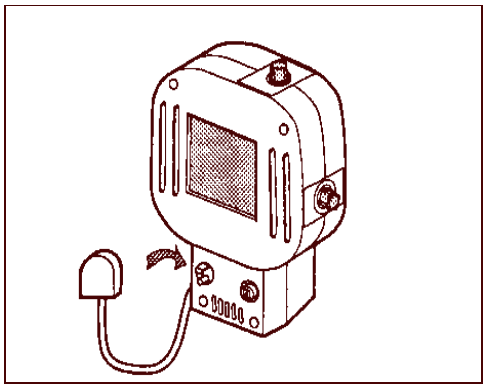


Fig. 21 Collimator

Flouroscopy tubus (22/1)/Dentaltubus (22/2) serve as spacers for the more exact

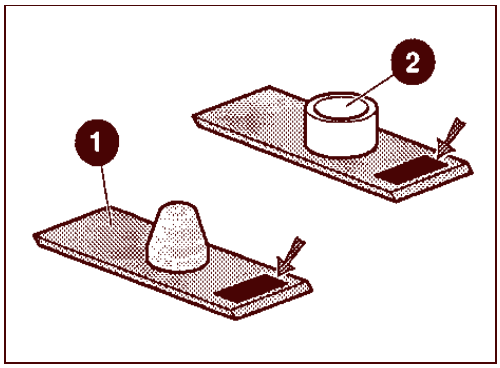


Fig. 22 Flouroscopy tubus/Dentaltubus

The gettertubus (23) is a comprehensive lead cover for the execution of functions checks and burn in (gettering). With the operation of the gettertubus no radiation penetrates outward.

REFERENCE

The Gettertubus can be stored in the drawer of the bit map memory unit during completely assembled X – Ray System

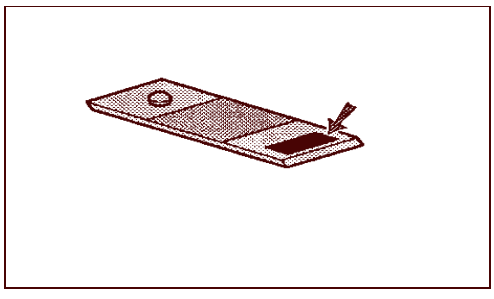


Fig. 23 Gettertubus

The double foot switch (24) consists of a metal design with two tracers. The double foot switch is to be served with a foot guidance equipped and thus only from a side correctly

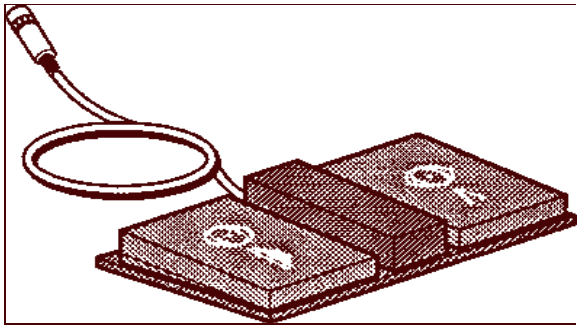


Fig.24 Double foot switch

The arranging baskets (25) are installed at the C-arm and to make it easier the installation and. dismantling of the image intensifier unit and the X-ray source

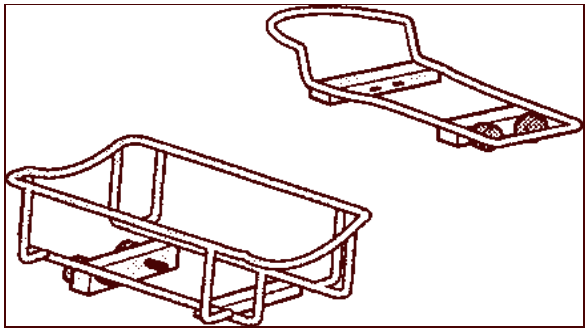


Fig.25 Arranging baskets

The cartridge holder (26) consists of a metal design and is used for the attachment of arbitrary radiography cartridges at the image intensifier unit

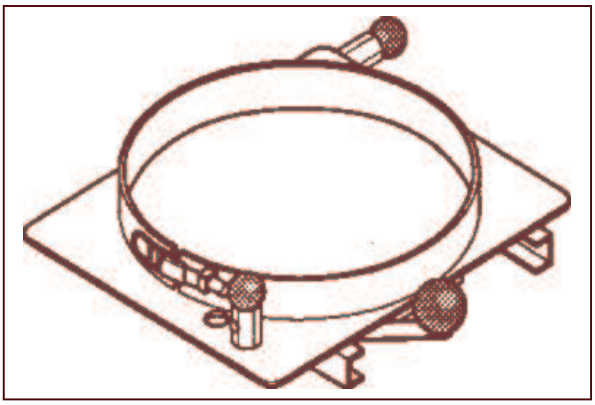


Fig.26 Cartridge holder

The sterile cloth covers (27) consist of a washable/sterilizable textile tissue.

There are two types:

1. Oblong, equipped with pushbuttons for the C - arm
2. Rectangular, equipped with tiebacks for the X-ray source and the image intensifier unit.

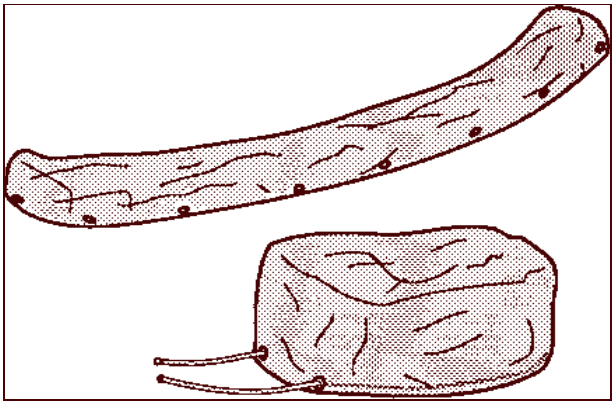


Fig.27 Sterile covers

1.4 Equipment

1.4.1 X – ray unit

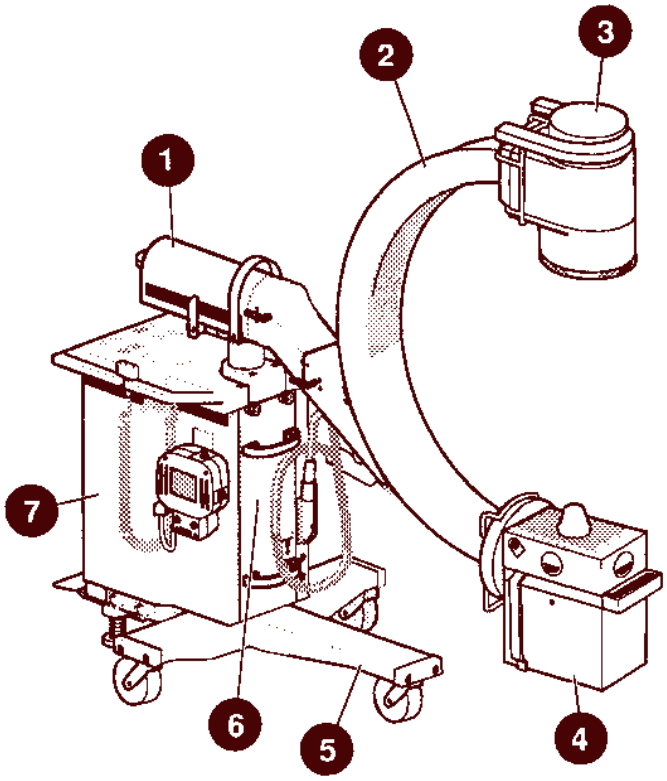


Fig. 28 X – ray unit

Number	Description	Remarks
1	C-arm bracket	
2	C-arm with cable	
3	Image intensifier unit with arranging basket	
4	X – ray source with arranging basket	Fluoroscopy tubus installed
5	Chassis	
6	Stroke column	
7	Electronics block	Collimator hang up

1.4.2 Display unit

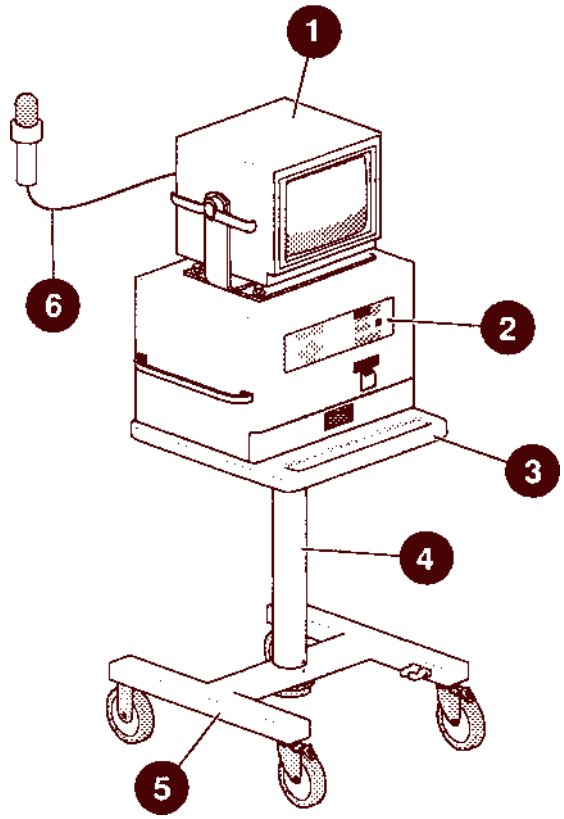


Fig. 29 Display Unit

Number	Description	Remarks
1	Display unit	
2	Bit map memory unit	
3	Support plate	
4	Desk top carrier	
5	Basic frame	
6	Radiation indicators	

1.4.3 Accessories

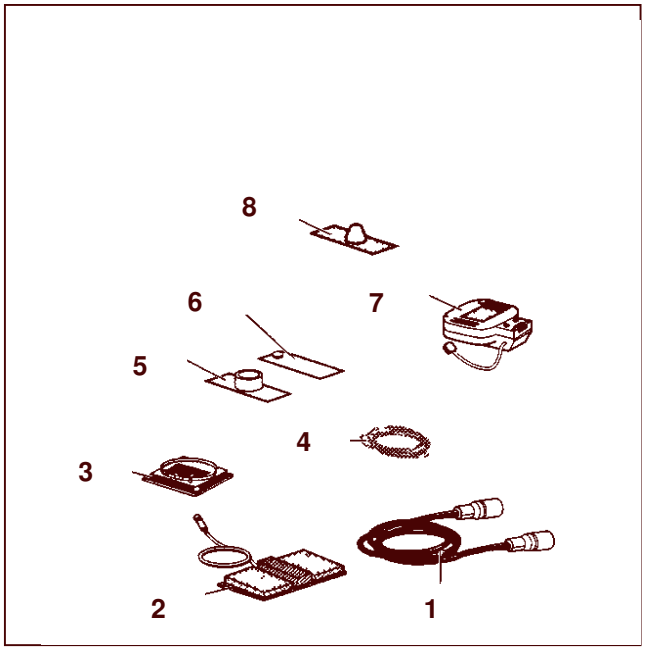


Fig. 30 Accessories

Number	Description	Remark
1	Cable connection X - Ray unit/bit map memory unit	
2	Double foot switch	
3	Cartridge holder	
4	Potential equalization cable	
5	Dentaltubus	
6	Gettertubus	
7	Collimator for radiography (cartridge technology)	
8	Flouroscopy tubus	
9	Screwdriver	not shown
10	Fuses and spare lamps	not shown
11	Equipment handbook	not shown
12	Documentation	not shown

1.4.4 Contents of the individual containers

1.4.4.1 Container 1/8

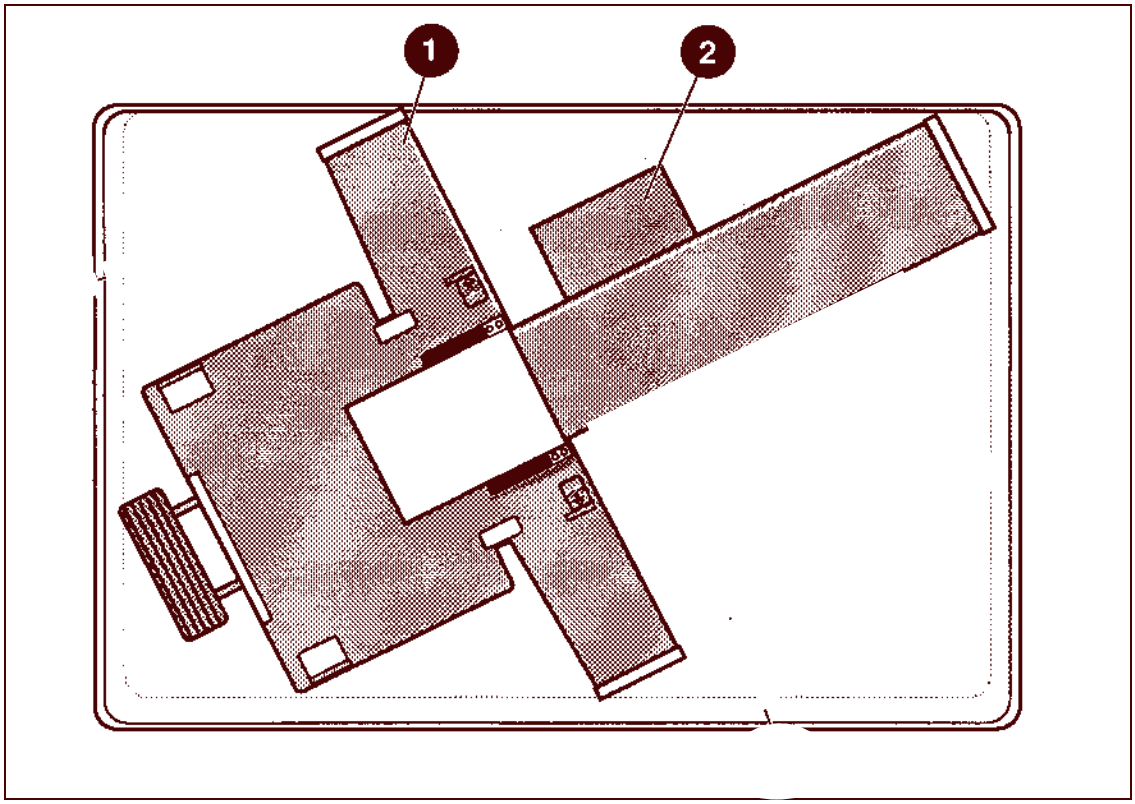


Fig. 31 Container 1/8

Number	Description	Remark
1	Chassis	
2	Documentation	

1.4.4.2 Container 2/8

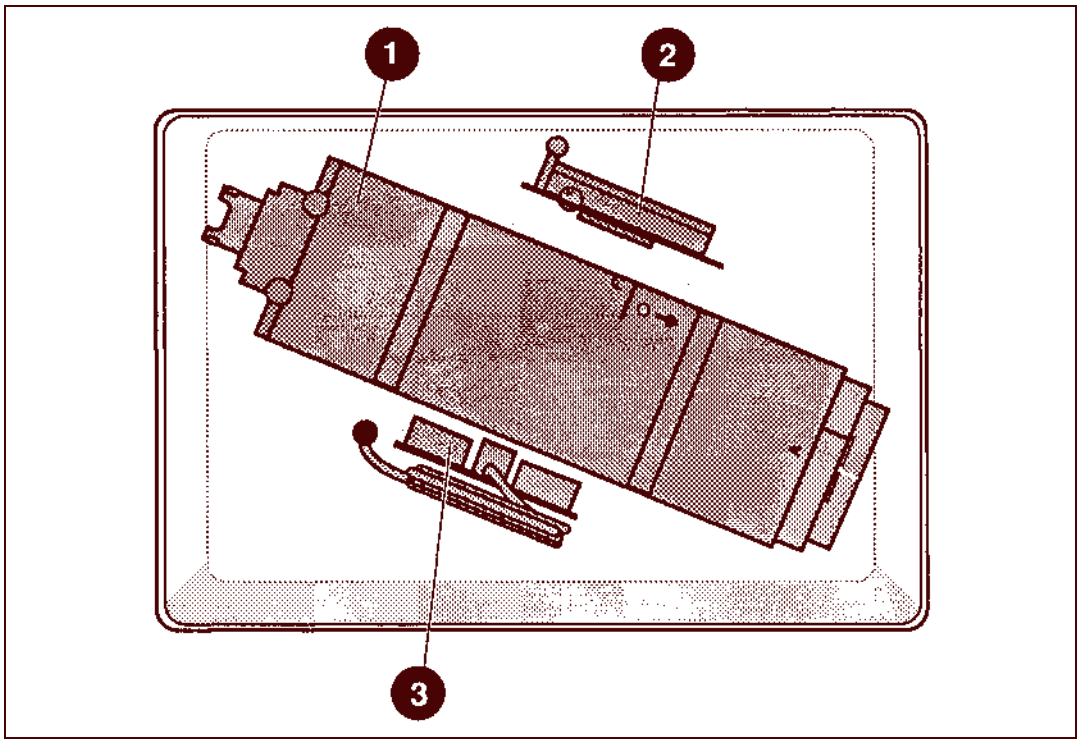


Fig. 32 Container 2/8

Nr	Description	Remark
1	Stroke column	
2	Cartridge holder	
3	Double foot switch	

1.4.4.3 Container 3/8

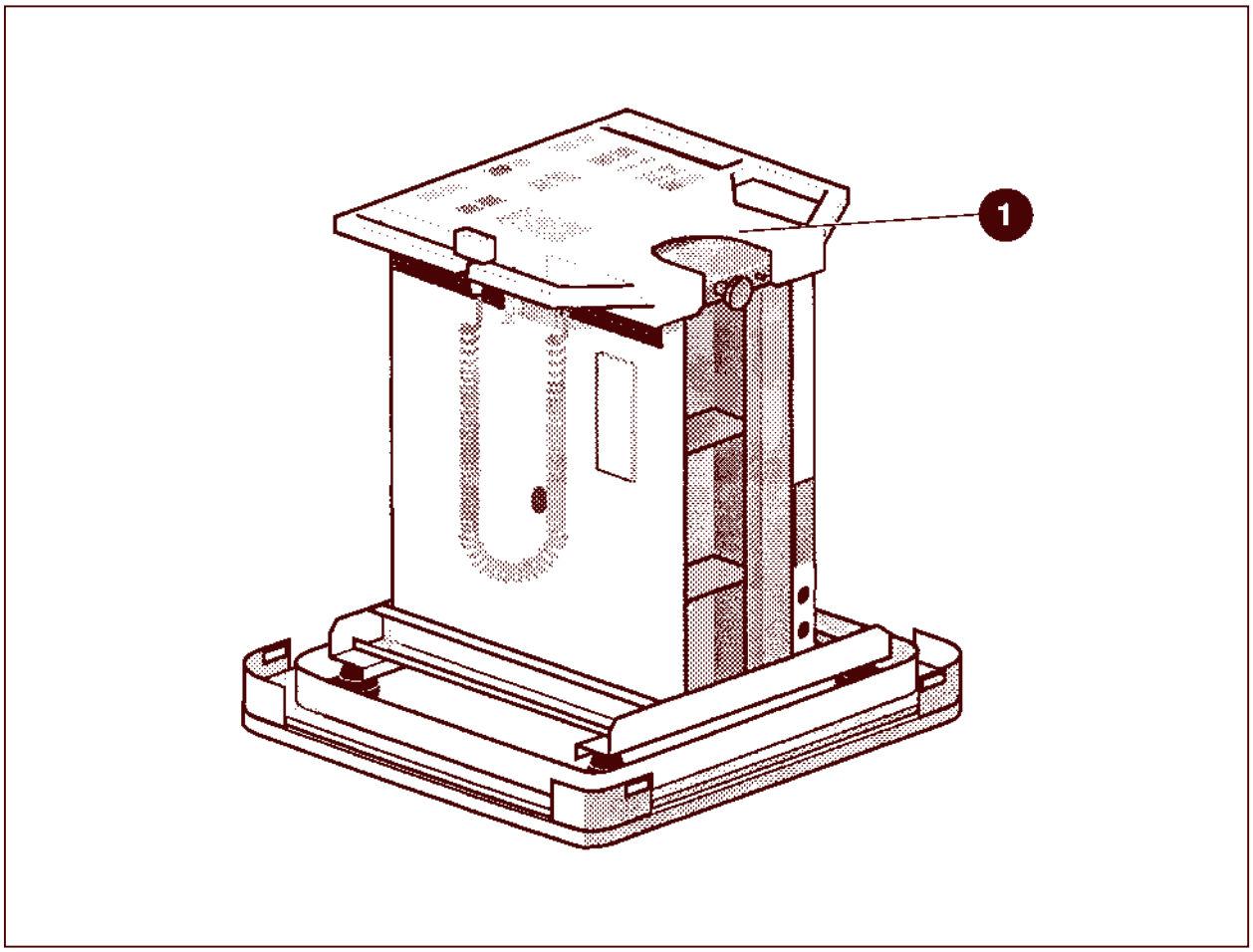


Fig.33 Container 3/8

Number	Description	Remark
1	Electronics block	

1.4.4.4 Container 4/8

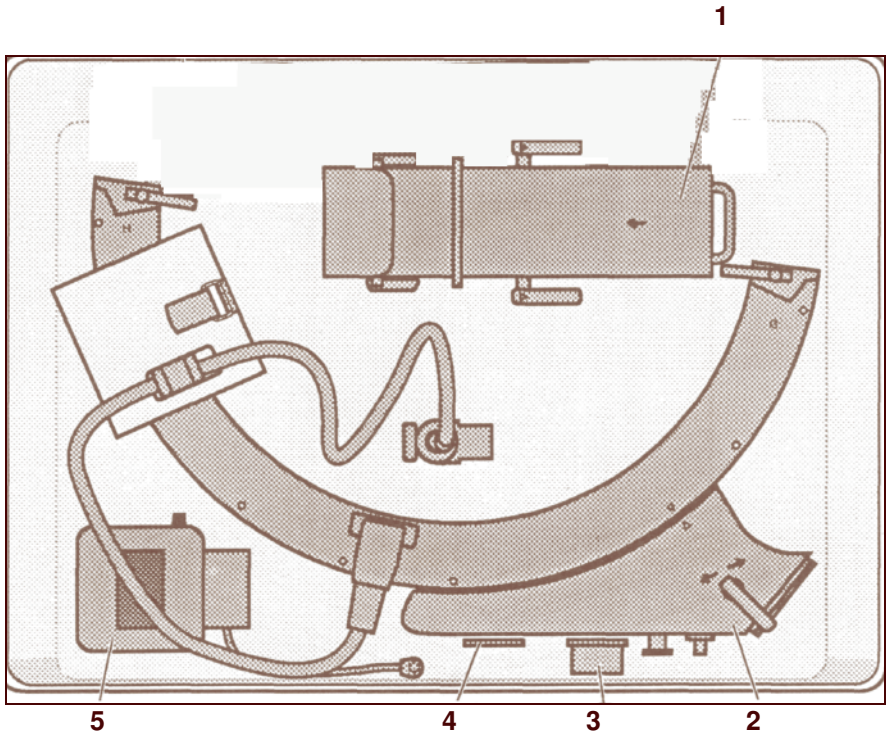


Fig. 34 Container 4/8

Number	Description	Remark
1	C-arm bracket	
2	C-arm	
3	Dental tubus	
4	Getter tubus (plate with plum bum)	
5	Collimator	

1.4.4.5 Container 5/8

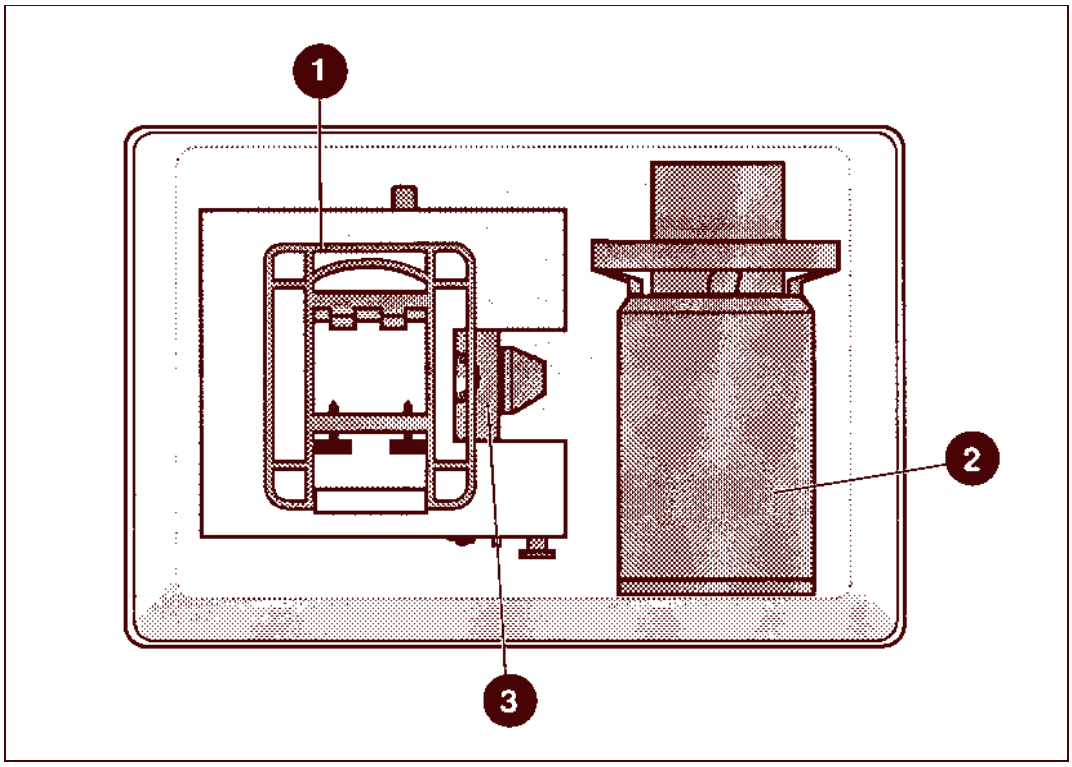


Fig. 35 Container 5/8

Number	Description	Remark
1	Arranging basket image intensifier unit Arranging basket X-ray source	
2	Image intensifier unit	
3	Flouroscopy tubus	at the X-ray source installs
4	X-ray source	underneath the arranging baskets

1.4.4.6 Container 6/8

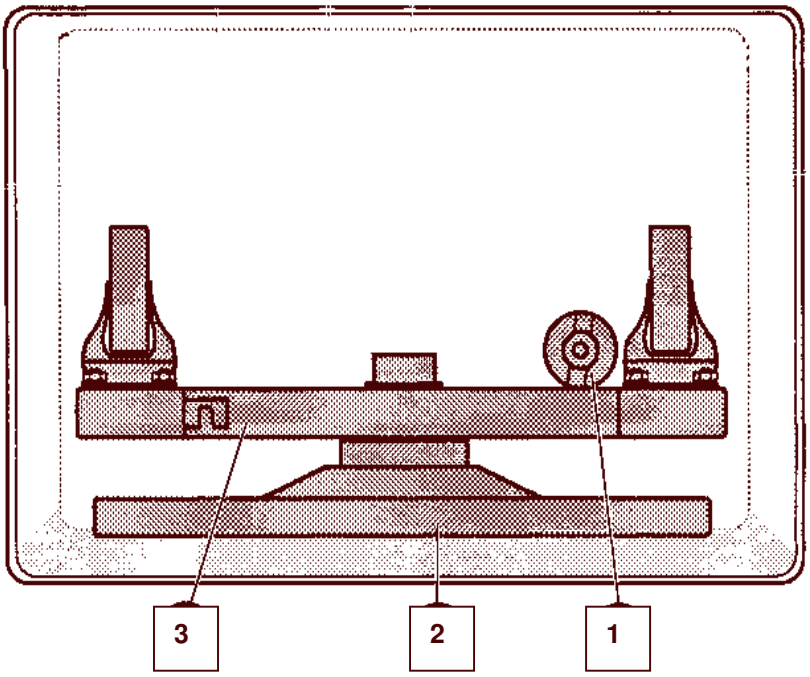


Fig. 36 Container 6/8

Number	Description	Remark
1	Desk top carrier	
2	Support plate for bit map memory unit and display unit	
3	Basic frame	

1.4.4.7 Container 7/8

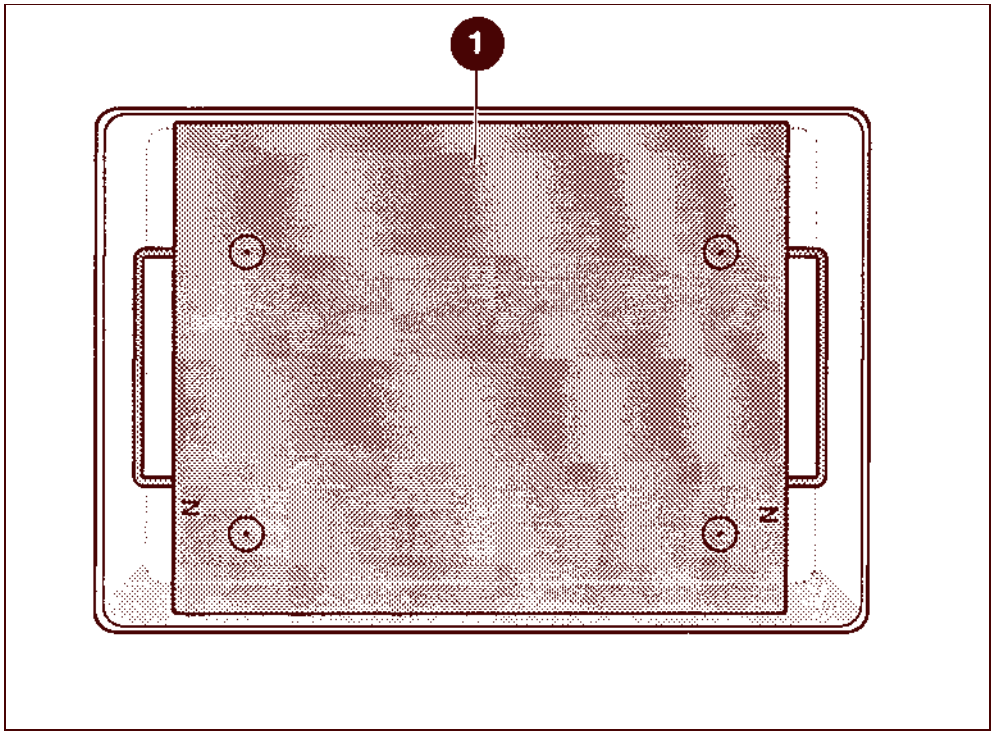


Fig. 37 Container 7/8

Number	Description	Remark
1	Bit map memory unit Contents of drawer: Radiation indicator Screwdriver Fuse 10 A fast Fuse 15 A fast Fuse 30 A fast Halogen bulb 12 V/AC Lamp, glow, 24-30 V Floppy disk 3.5", 2HD	with drawer 2 pieces 2 pieces 2 pieces 2 pieces (collimator) 1 pieces (radiation indicator)

1.4.4.8 Container 8/8

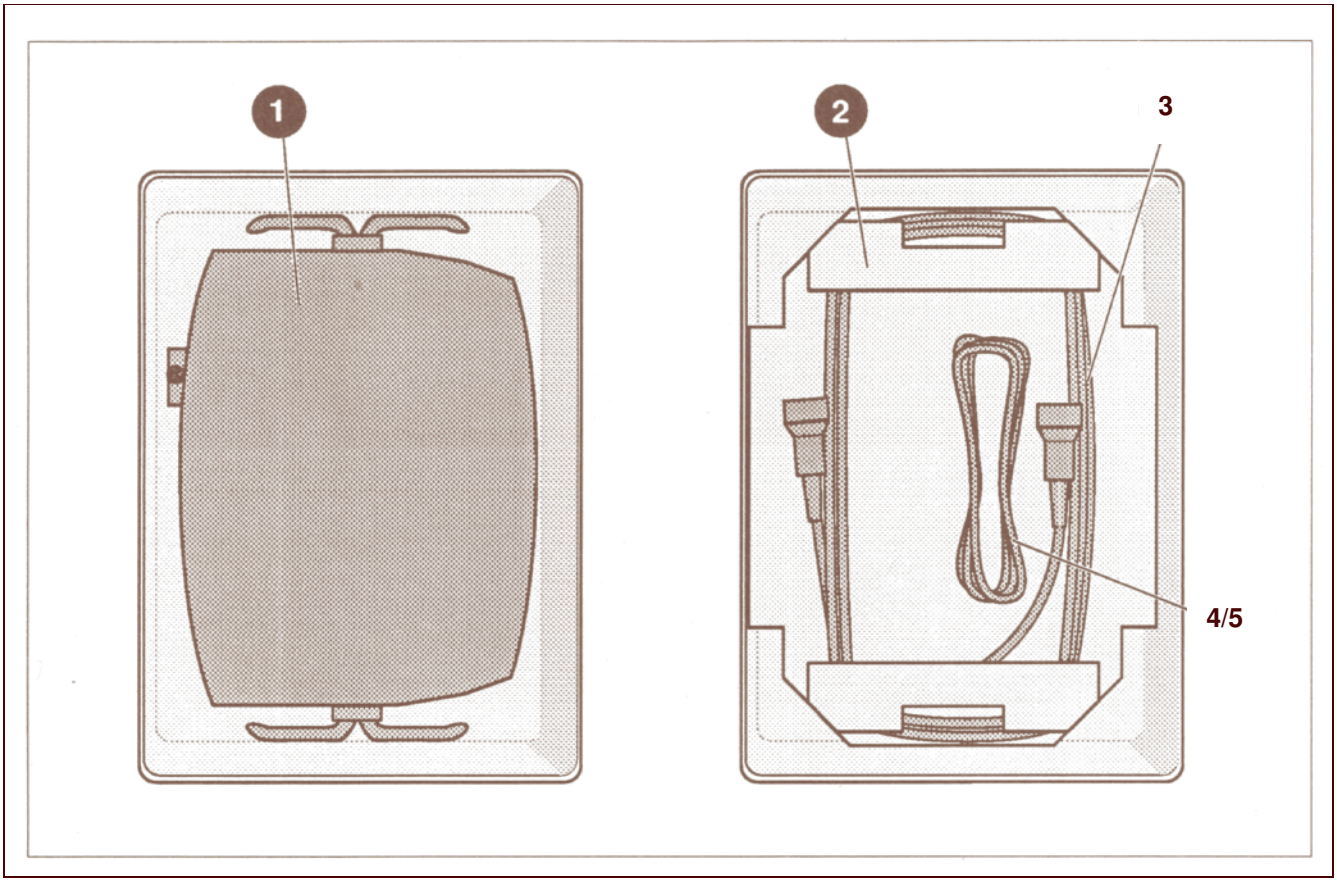


Fig. 38 Container 8/8

Number	Description	Remark
1	Display unit	
2	Cable carrier	
3	Cable connection with two connectors (male)	
4	Potential equalization line with lug and socket	
5	Potential equalization line with 2 sockets	

PART 2

Operation and Maintenance

2.0 System overview with junction points

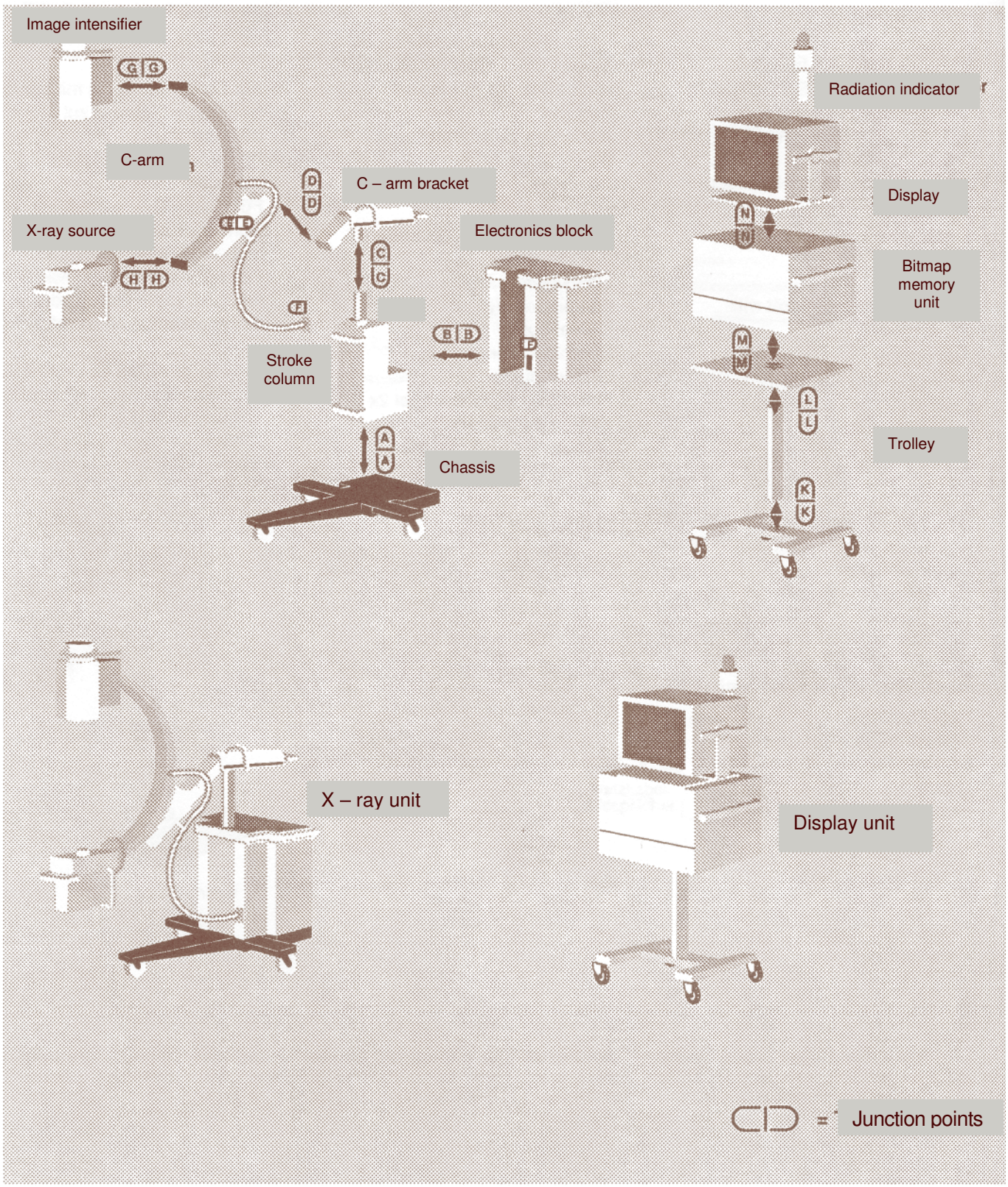


Fig.39 Subassemblies with alphabetical junction points

2.1 Building the X – ray system

2.1.1 Demands on the structure place

- It is a closed area with sufficient protection from precipitation is to be selected.
- The ground must be even and smoothly for the assembling.
- As mounting surface with storage surface for the containers must a minimum surface of approx.. 20 m² are available.
- The minimum ceiling height for the safe assembling of the C-arm must amount to 2.5 m.
- For the execution of the functions checks a power connection with 220 V - 50 cps must be present.

2.1.2 Preparations for the building up

- Container 1/8 to 8/8 according to the space conditions outside of the mounting surface.
- Make the containers only in the order of the work procedures open.
- Before take out the assembly's open and unfold the mounting plates into the container, after taking out the assembly's close and secure the mounting plates.
- Containers after take out the assembly's close and put down at outside of the work area.
- For the assembly the system 2 men is necessary, whereby the appropriate training must have.

ATTENTION

All locking mechanism marked in red color (exception transport lock C-arm) for the safety device of connections!

These connections may not be loosening during the operation!

2.1.2.1 Marking of the junction points

The junction points of the individual assembly groups are alphabetically characterized.

The assembly groups are according to this marking beginning with A/A to always assemble (in the picture is represented for technical reasons of B/B).

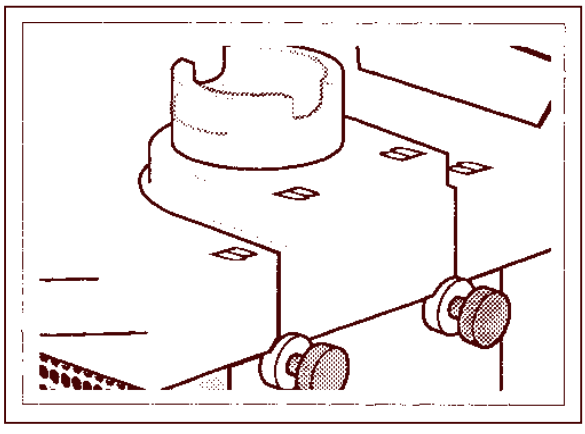


Fig. 40 Marking of the junction points

2.1.2.2 Position of the integrated red stop knobs

The securing knobs at the levers of the C - arm may be put up only for the loosening of the levers.
They must be turned afterwards immediately again into the engaged position, so that they engage automatically with the structure of the equipment into the pawls.

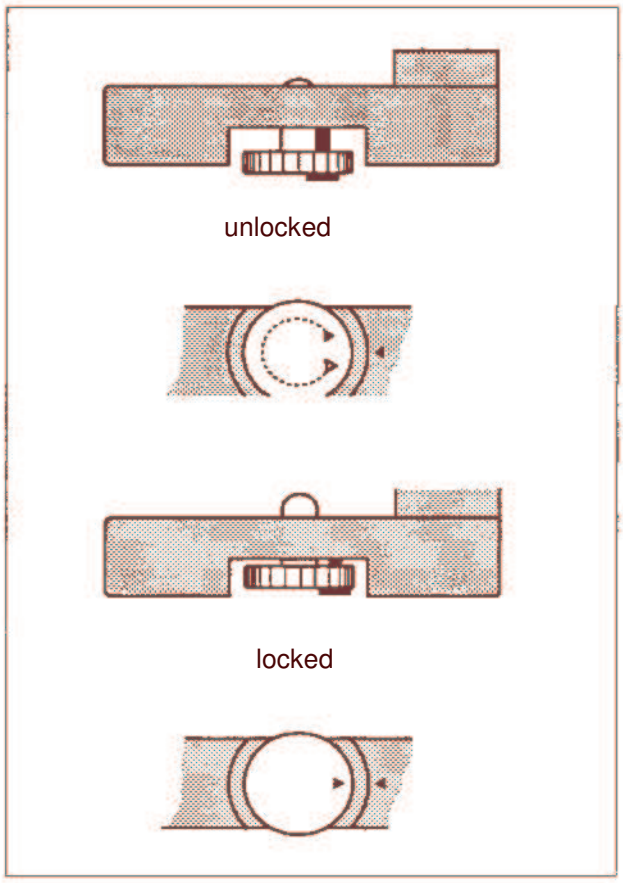


Fig. 41 Stop knobs

2.1.2.3 Visual inspection during the assembly

- All connections of the components for tightness examine; all mechanical safety devices in the prescribed position.

REFERENCE

- The attachments of the plugs and the plug sockets at the C -arm etc. are consciously mobile developed. When assembling the plug can align itself properly matching in each case to adjust at the correct position.

- All cable and connections on outward damages examine.

- Parts may not do transport damages, as depressions, tears or breaks to exhibit.

2.1.3 Assembling X – ray unit

Container 1/8 contents:

1 - Chassis
2 - Documentation

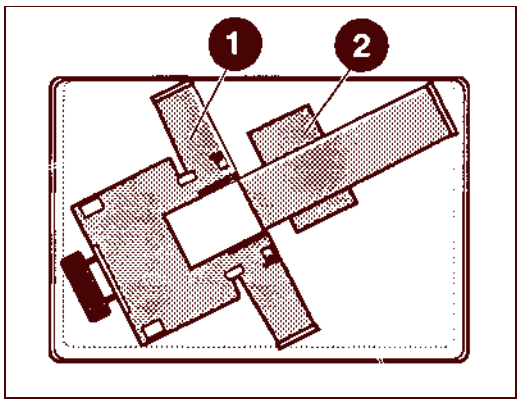


Fig 42 Contents of container 1/8

1. Chassis of the container take out and set it off.
2. Foot brake (43/1) determine: A man places himself on the front arm, second steps on the pedal of the foot brake (rubber lining)

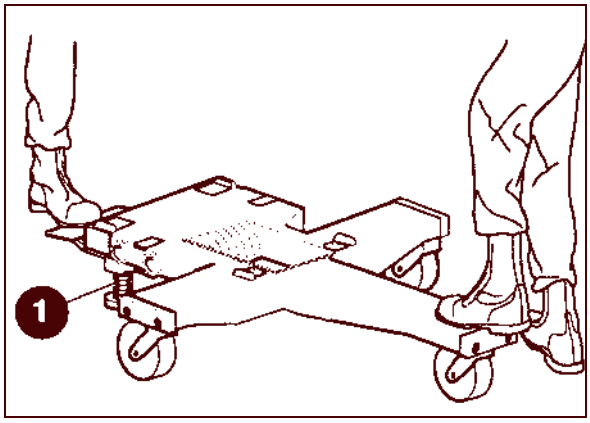


Fig. 43

Container 2/8
Contents
1 Stroke column
2 Cartridge owner
3 Double foot switches

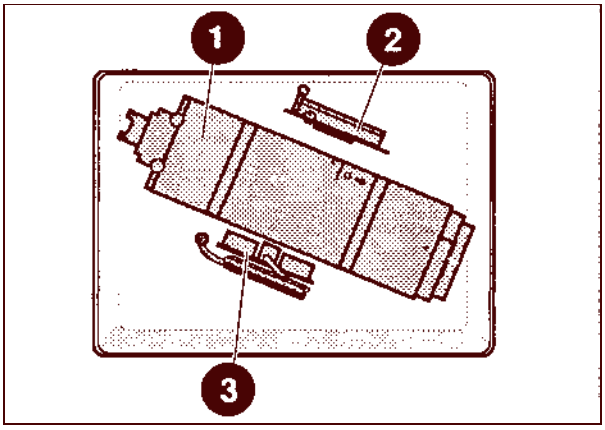


Fig. 44

3. Stroke column take it out.

ATTENTION

The stroke column weight approx. 50kg!

Stroke column with the markings A-A into the recess in the chassis to slide diagonally let put up and, until the locking latch plates (45/1) engage audibly.

5. If the x-ray unit is to be served later with the foot switch, this is to be taken out and put down from the transportation container.

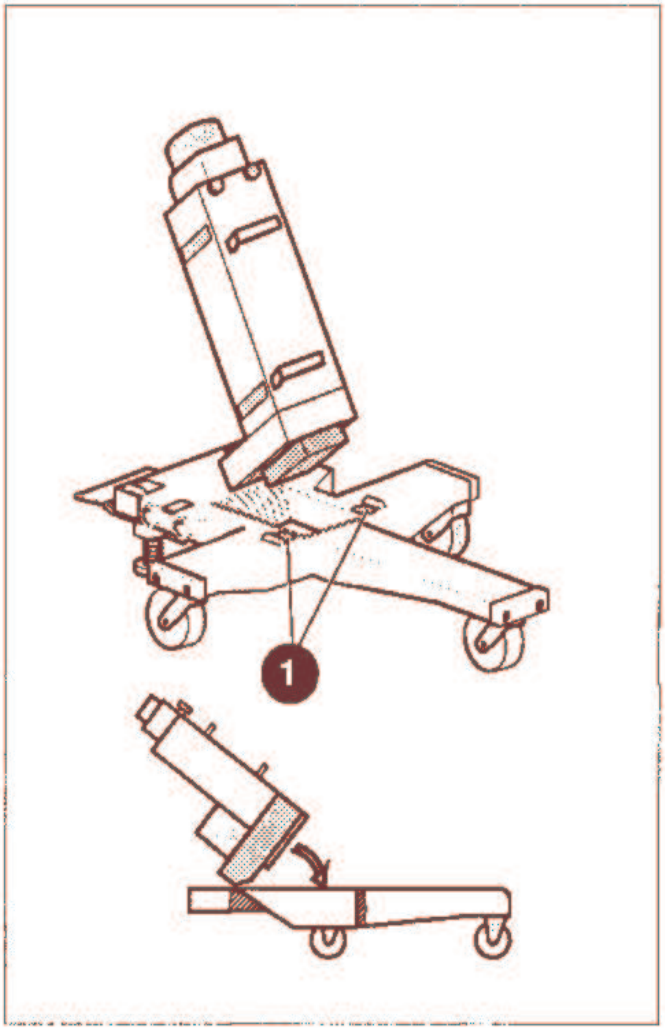


Fig. 45

6. Both locking pins (46/1) pull out and turn to them in the loosened position stop.

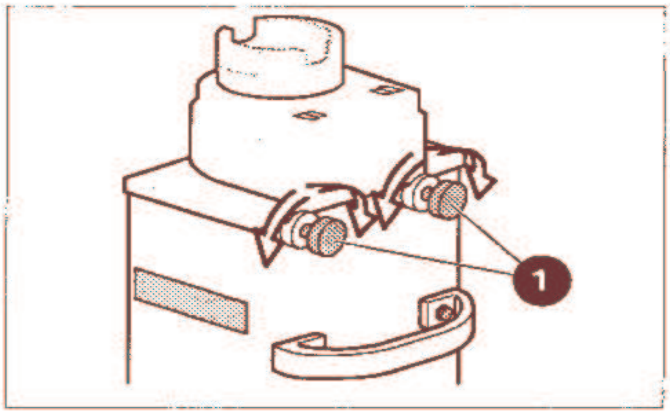


Fig. 46

Container 3/8

contents:

1 – Electronic block

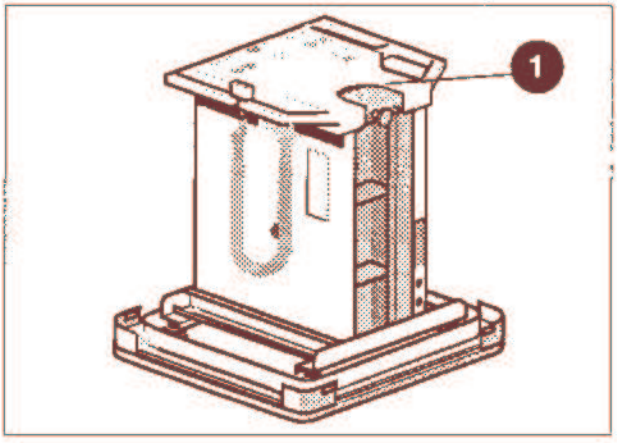


Fig. 47 Contents: container 3/8

7. Bolting device by pulling out and rotation of the stop knob (48/1) loosen and the electronics block can take out at the hand rail 5 cm raise and move to the rear.

ATTENTION

The electronics block weighs approx.. 90 kg!

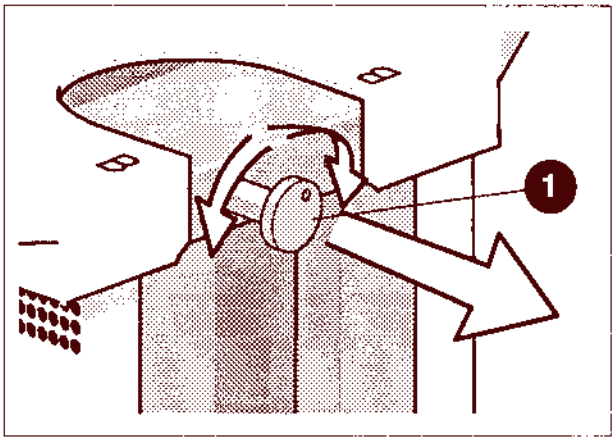


Fig. 48

8. Electronics block in such a way from the rear to the column set that the markings B-B face each other. About 5-6 cm over the chassis horizontal to the column advance and put slowly lower, without tilting the block.

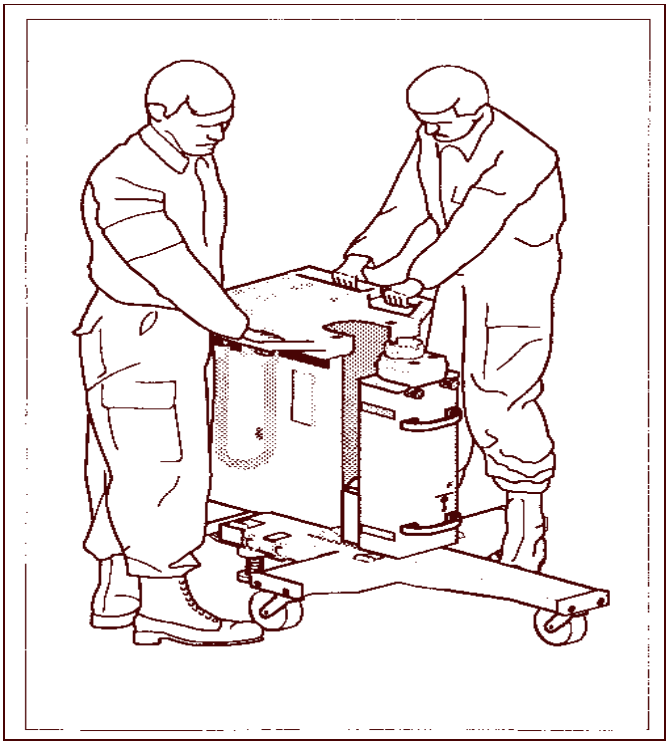


Fig. 49

9. Both stop knobs (50/1) turn, until they engage.

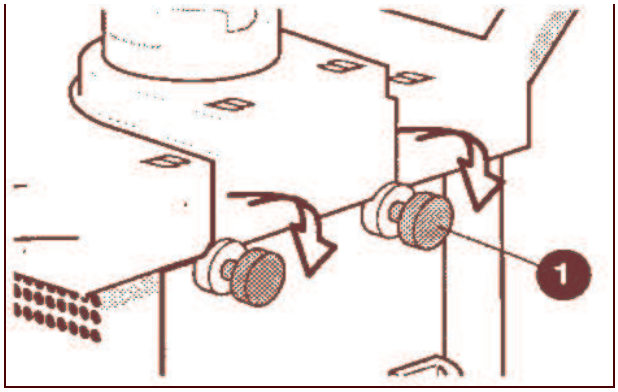


Fig. 50

Container 4/8

contents:
1 - C-arm bracket
2 - C-arm
3 - Dental tubus
4 - Getter tubus
5 - Collimator

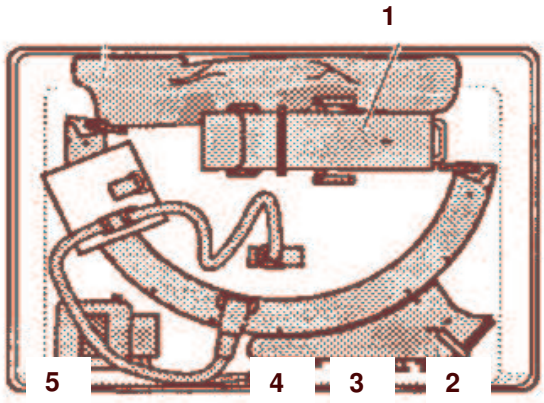


Fig. 51 Contents: container 4/8

10. The Gettertubus and the Dentaltubus are to be taken from the container and put down.

ATTENTION

The C-arm bracket weighs approx.. 25 kg!!

C-arm bracket in such a way on the stroke column put on that the markings CC. After putting on the brake lever for fan movement (52/1) horizontal direction (brake determined).

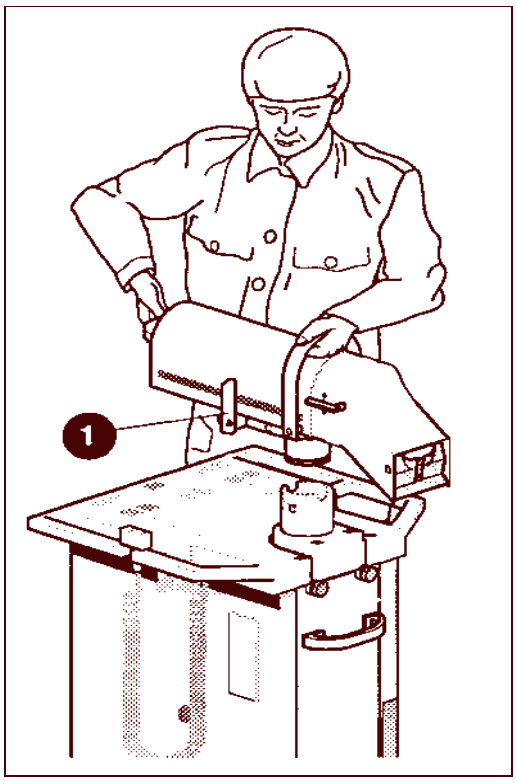


Fig. 52

11. The brake lever for fan movement (52/1) in vertical position place and the C-arm bracket put it out.

Attention

It control whether the brake for forward / backward motion (53/1) is determined (brake levers in horizontal position)!

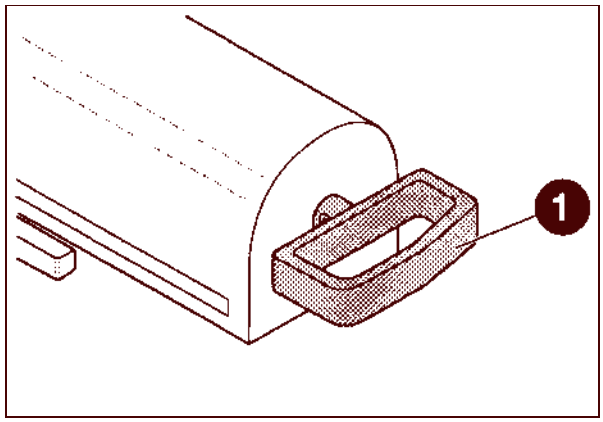


Fig. 53

12. Remove cables and cable support from the attachment (54/3) by loosen fixing bolt of the wall plug (54/1) and cables around the shoulder hang over it.

    C-arm (54/2) from the container take out.

ATTENTION

The C - arm weighs approx. 35kg!

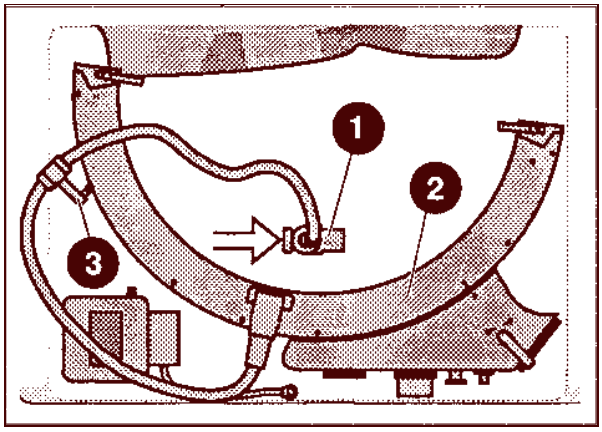


Fig. 54

13. C-arm in such a way into the mounting plate at the C-arm-bracket arm postpone that the markings of D - D face each other. The security lock (55/1) engages audibly.

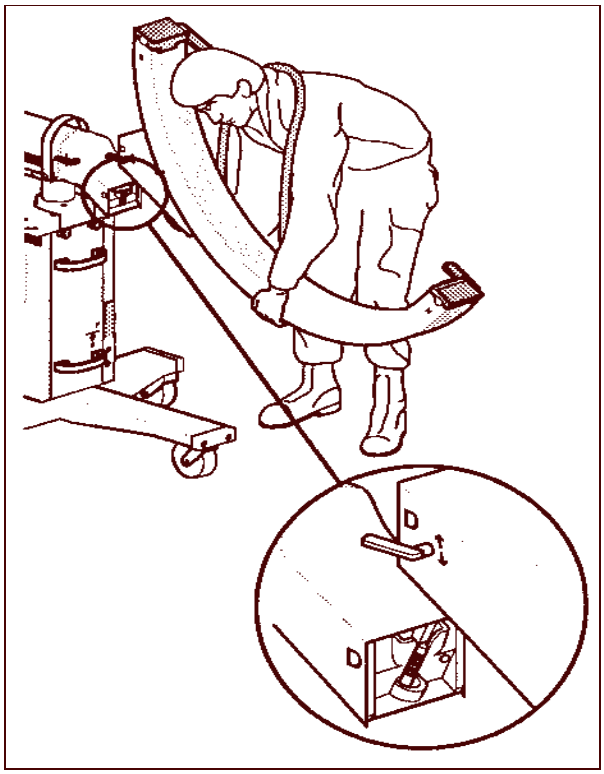


Fig. 55

14. C-arm by tightening the locking grip (arrow 56/2) in the clockwise direction secure. Afterwards the transport lock pull out (arrow 56/3) turn and into the use position.

REFERENCE

Is not the transport lock in use position, then the brake lever for the circulation (56/4) is blocked.

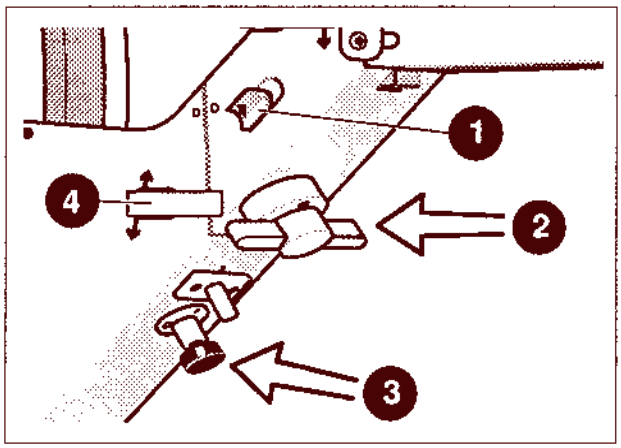


Fig. 56

15. Cables of the C - arm straight lead away and make sure that it does not twist itself. The cable under the C - arm accomplish. In such a way cable support (57/2) to the attachment (57/1) stick on that the markings **E**-**E** face each other. Pull the securing knob out. After the plug-on locking must engage perceptibly.
The cable end loosely over the hand hang and examine that it does not rotate.

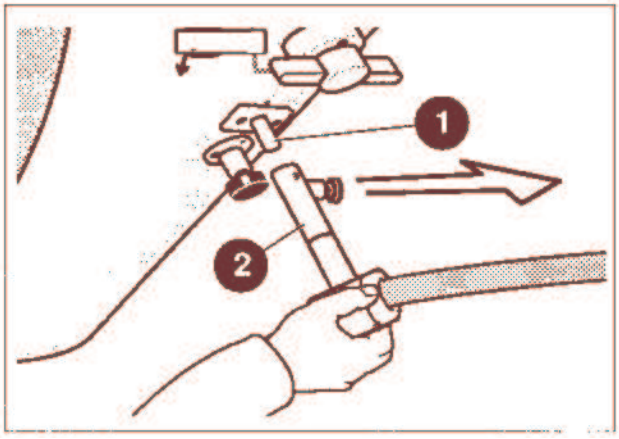


Fig. 57

15. The connector under the C - arm lead back and in such a way into the plug socket put that the markings **F**-**F** face each other.

Plugs with the knurled thumb screw tighten.

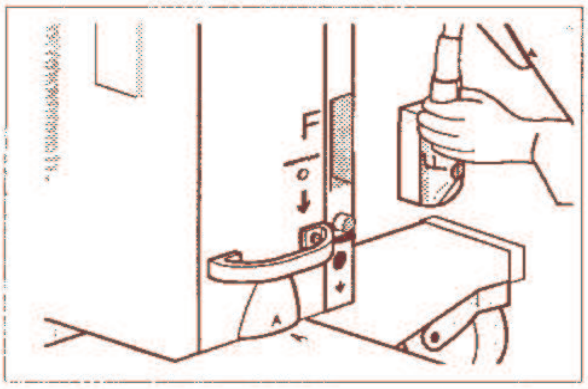


Fig. 58

17. Collimator from the container take out, at the electronics block hang up and the cable into the dummy socket put. The retaining plates of the tubes and the collimator are characterized in the side by, in the opposite side by two red points. They are to be used according to these markings.

If with the X – ray system no Radiography operation to be accomplished is, the collimator is not needed.

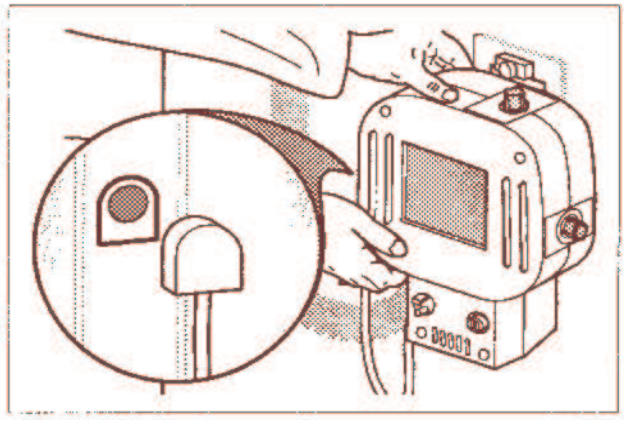


Fig. 59

18. Brake by putting the brake lever up for the circulation (60/1) loosen and the C - arm into the horizontal position push. Subsequently, the brake by pressing the brake lever (60/1 down) tighten.

The safeguard lever for the BV unit (60/2) and the safeguard lever for the X-ray source must stand inward, the stop knobs must engaged, i.e. in the lower position must be located. Possibly turn stop knobs, they are automatically lock in.

ATTENTION

The stop knobs at the levers of the C - arms may be pull up only for the loosening of the levers! They must be turned afterwards immediately again into the engaged position, so that they engage automatically with the further structure into the locking position (see fig. 40)!

REFERENCE

The attachments of the plugs and the plug mountings at the C - arm etc. are consciously mobile developed. When assembling the plug can align itself properly matching in each case to the mounting position.

Container 5/8 contents:

1 - X-ray source with Flouroscopy tubus
2 - Image intensifier unit
3 - Arranging basket X-ray source and image intensifier unit

19. The two arranging baskets pull out from the attachment.

20. The image intensifier unit arranging basket (62/1) at the internal end of the C - arms attach.

The knurled thumb screws must show outward.

The image intensifier unit arranging basket with the help of the red knurled thumb screws (62/2) must be secure.

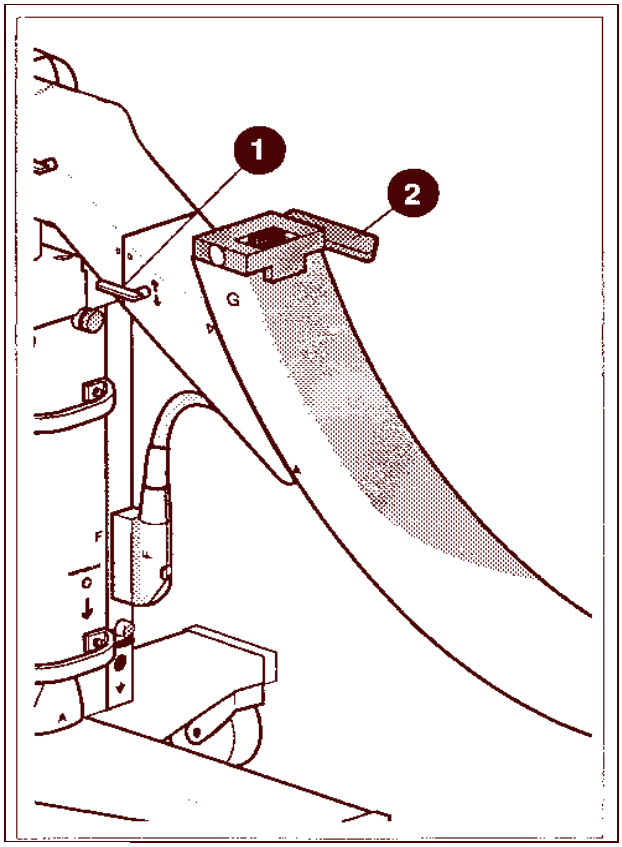


Fig. 60

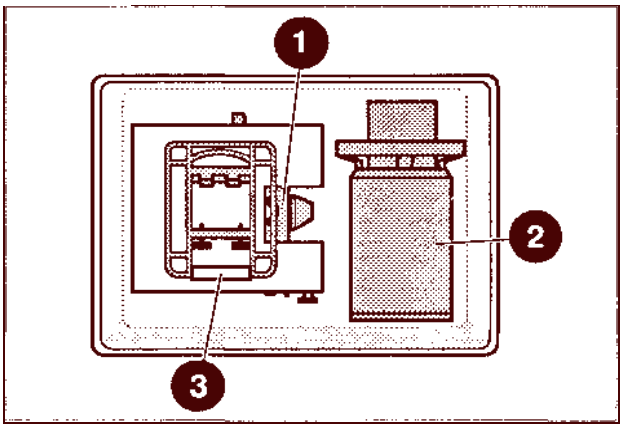


Fig. 61 Contents container 5/8:

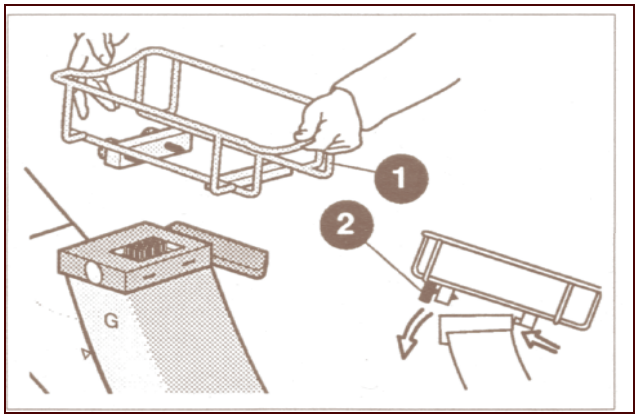


Fig. 62

21. The X-ray source arranging basket (63/1) at the outside end of the C - arms attach.
The knurled thumb screws must show outward.

The X-ray source arranging basket with the help of the red knurled thumb screws (63/2) must be secure.

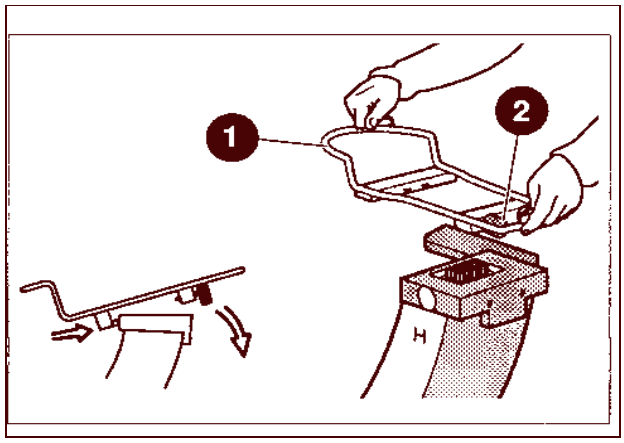


Fig. 63

ATTENTION

The image intensifier unit must be installed always first at the C - arm! Never install the X – ray source first!!

22. Spring-actuated lock loosen and the retaining cover up of the image intensifier unit lift and put (64/1) out the unit from the container 5/8.

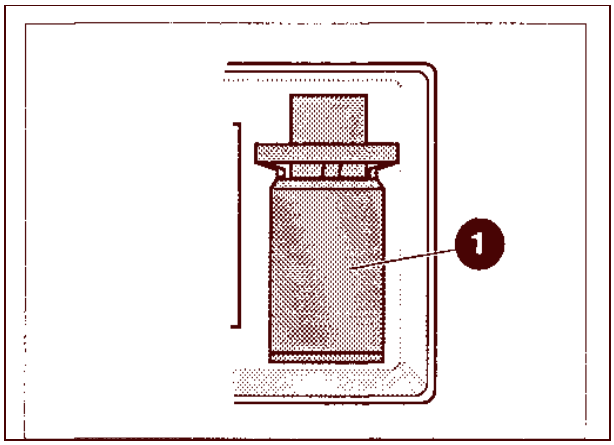


Fig. 64

ATTENTION

The image intensifier unit weighs approx.. 30 kg!!

BV unit from above into the basket to slide leave.
The markings **G-G** must face each other.

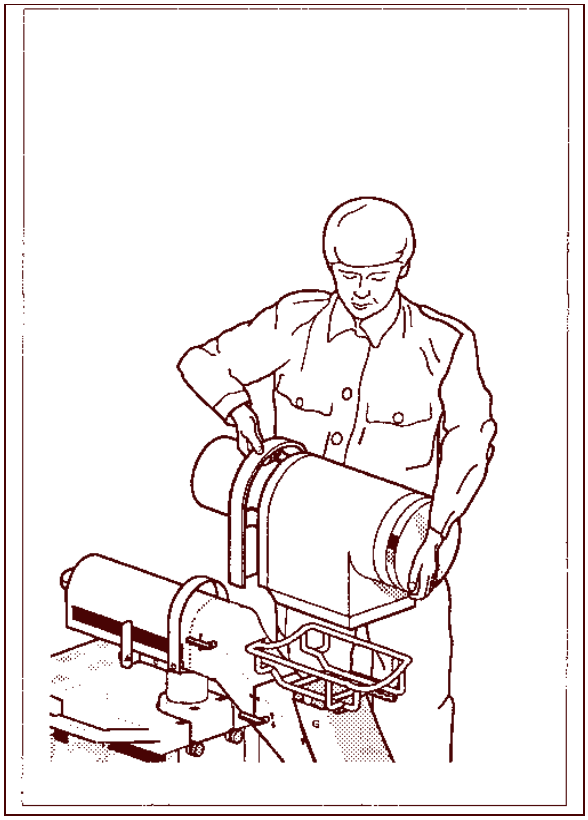


Fig. 65

23. Safeguard levers tighten, until the securing knob catches audibly. Engaging again control!

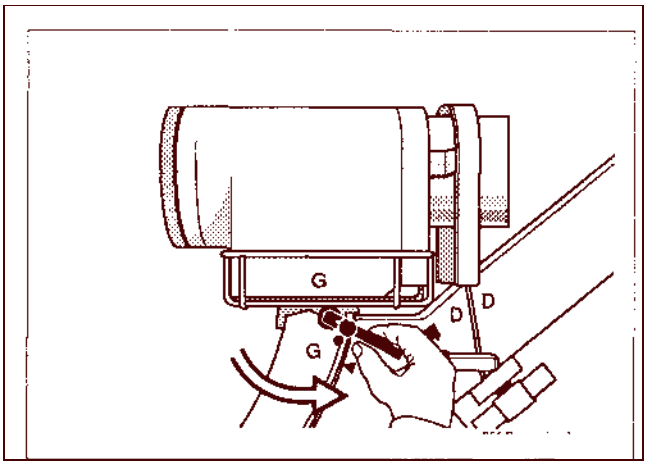


Fig. 66

24. X-ray source (671) from the container 5/8 take out.

ATTENTION

The X-ray source weighs approx. 25kg!

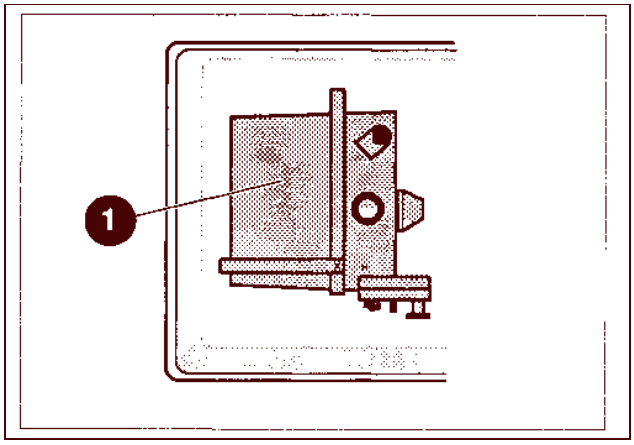


Fig. 67

25. X-ray source with the roundness inward to the basket advance the fact that the markings **H - H** spar face each other, lower the X – ray source and hold it to the safeguard lever is tightened.

26. Safeguard levers tighten, until the stop knob catches audibly. Engaging again control!

The X – ray source is now completely installed.

If the X - ray unit is to be used only for radiography operation, the structure is final. The assembly of the collimator is described in the section
" Radiography operation ".

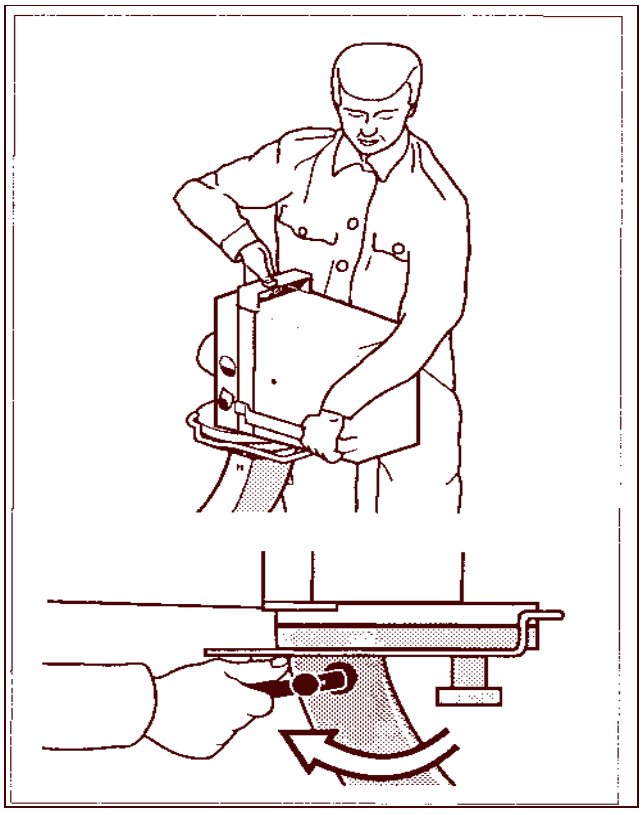


Fig. 68

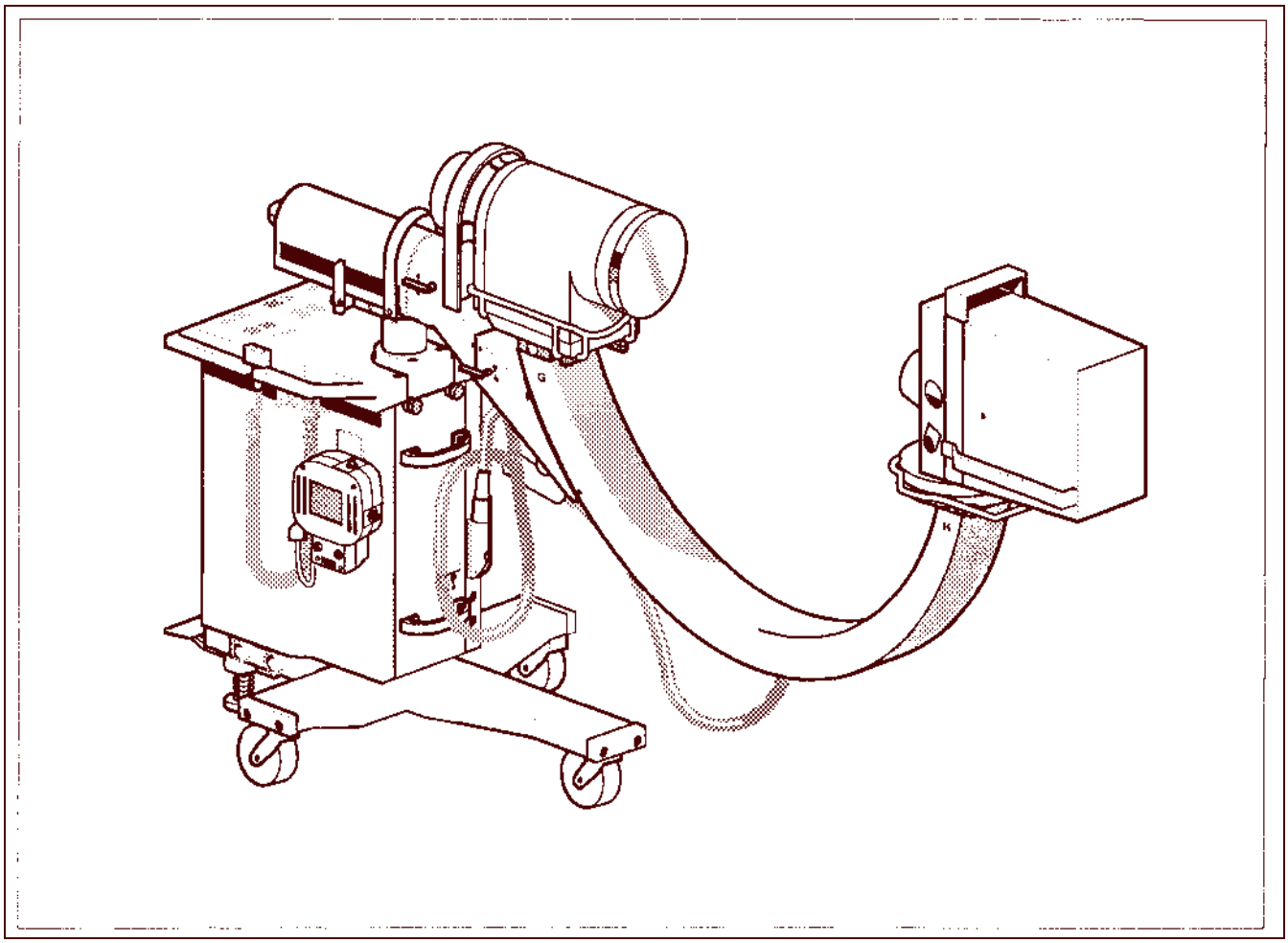


Fig. 69 X - ray unit completely installed

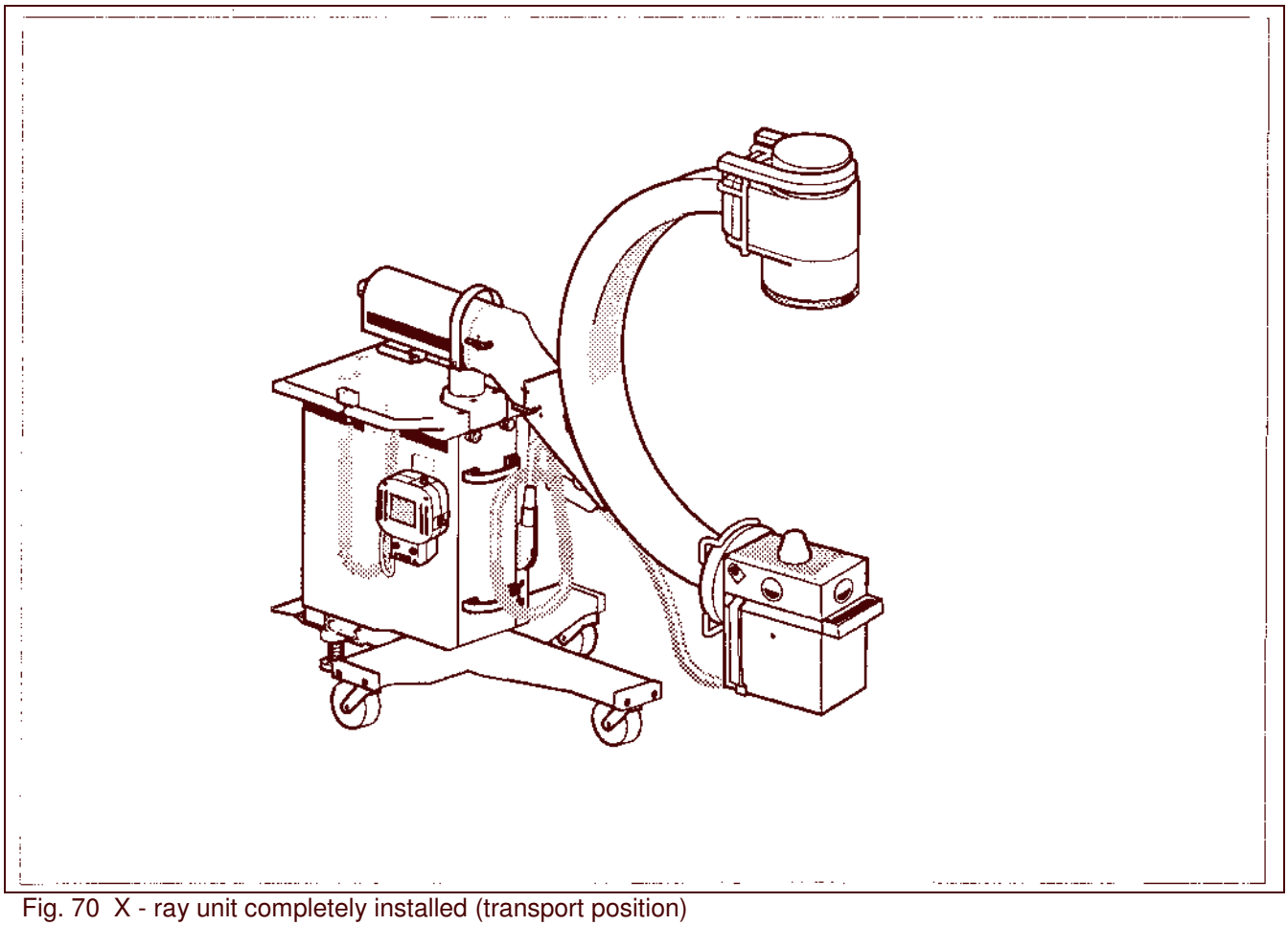


Fig. 70 X - ray unit completely installed (transport position)

2.1.4 Assemble the Display unit

Container 6/8 contents:

1 - Desk top carrier
2 - Support plate
3 - Basic frame

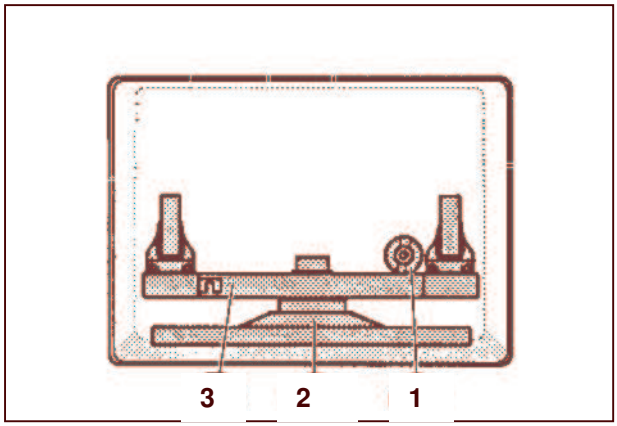


Fig. 71 Contents container 6/8

1. Basic frames take up and place it on the floor.
The brakes through pressures of the lever (72/2) loosen. The two mobile wheels outward place. The brakes through pressures of the lever (72/1) again tighten.

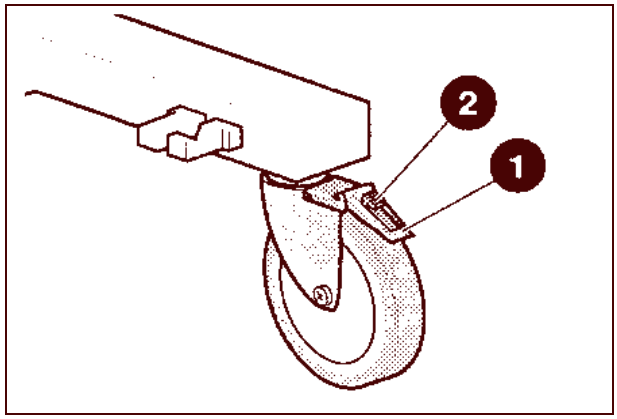


Fig. 72

2. Desk top carriers take it and in such a way on the basic frame set the fact that the two markings K-K face each other. The fixing screw with the hand wheel (arrow) upward press, and through tricks tighten.

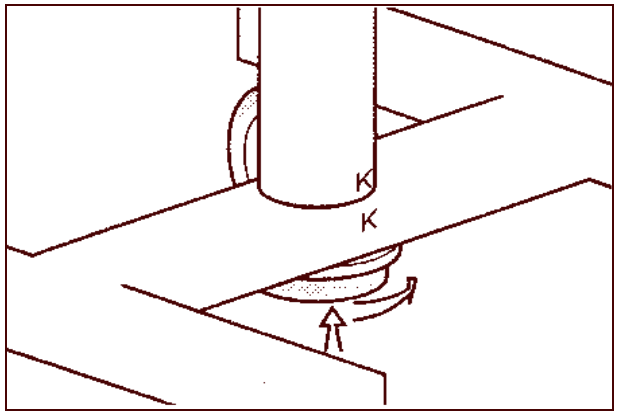


Fig. 73

3. Support plate take and in such a way on the support plate carrier set the fact that the two markings L-L face each other and with the fixing screw (hand wheel) (74/1) tightens.

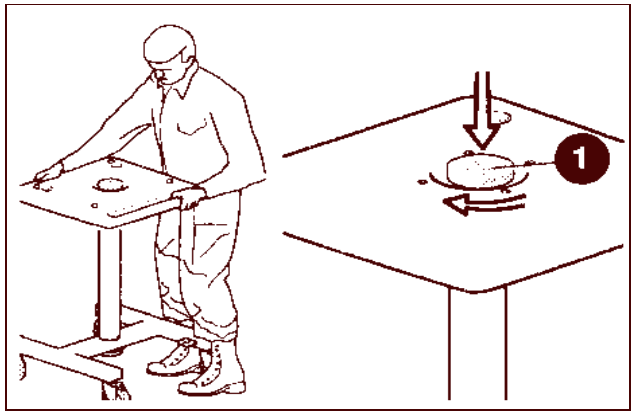


Fig. 74

Container 7/8 Contents:

1 - Bit map memory unit with drawer contents of the drawer:

1x Screwdriver
2x Fuse device 10 A, fast
2x Fuse device 15 A, fast
2x Fuse device 30 A, fast
2x Lamp 12 V/AC, halogen
1x Lamp, glow 24-30 V
1x Radiation indicator
60 x Floppy disks 3.5"2HD

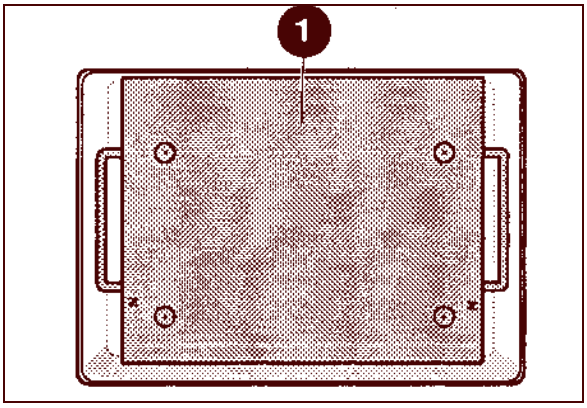


Fig. 75 Contents container 7/8

4. Bit map memory unit from the container take out and with the markings **M - M** face each other on the support plate place.

ATTENTION

The bit map memory unit weighs approx. 50kg!

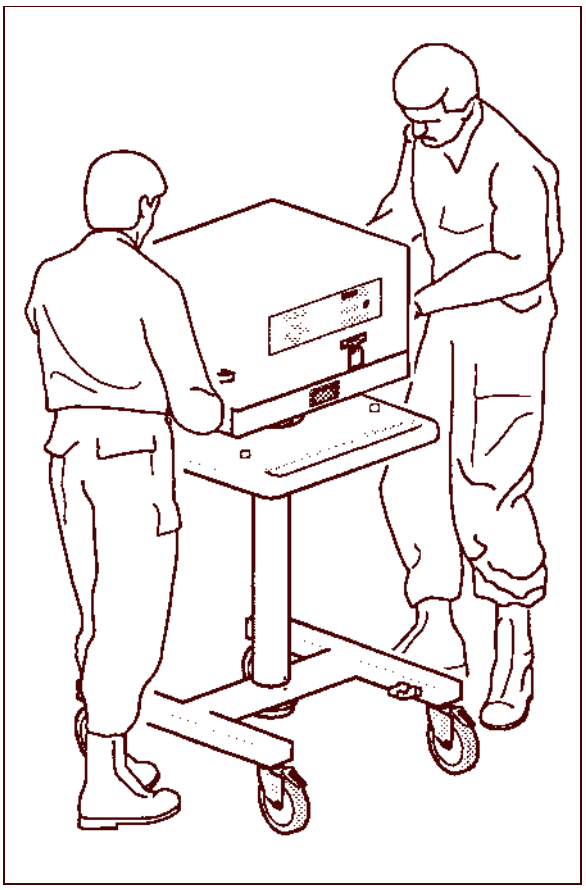


Fig. 76

5. The 4 fixing screws (arrow) towards to spring pressure press in and tightens

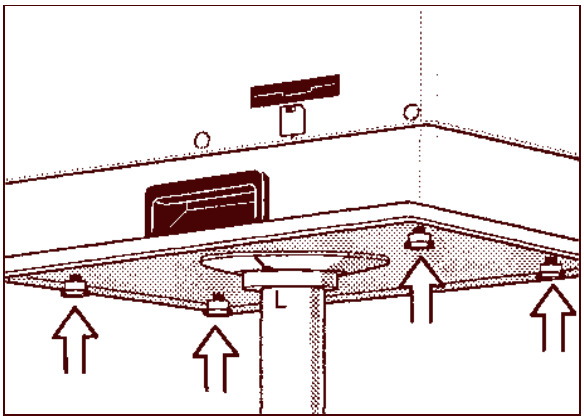


Fig. 77

Container 8/8

Contents:

1. Display unit
2. Potential equalization line with lug and socket
3. Potential equalization line with 2 sockets
4. Cable connections with 2 connectors (male)

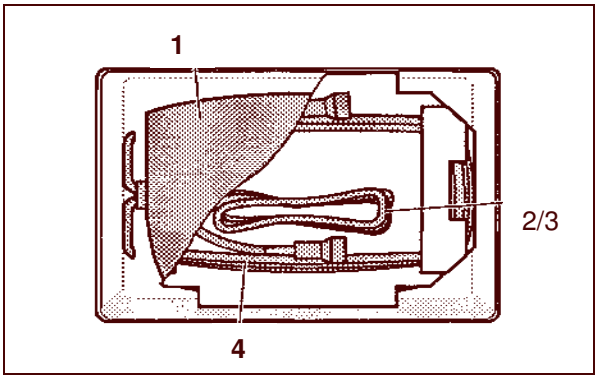


Fig. 78 Contents container 8/8

6. Take out the cable carrier and lay down.

7. The spring-actuated locks opening and the mounting plates (both sides) folding outward.

8. The display unit (78/1) from the container take out and with the markings **N-N** face each other on the bit map memory unit place.

The feet must be stand in the recesses.

ATTENTION

The display unit weighs approx.. 40 kg!

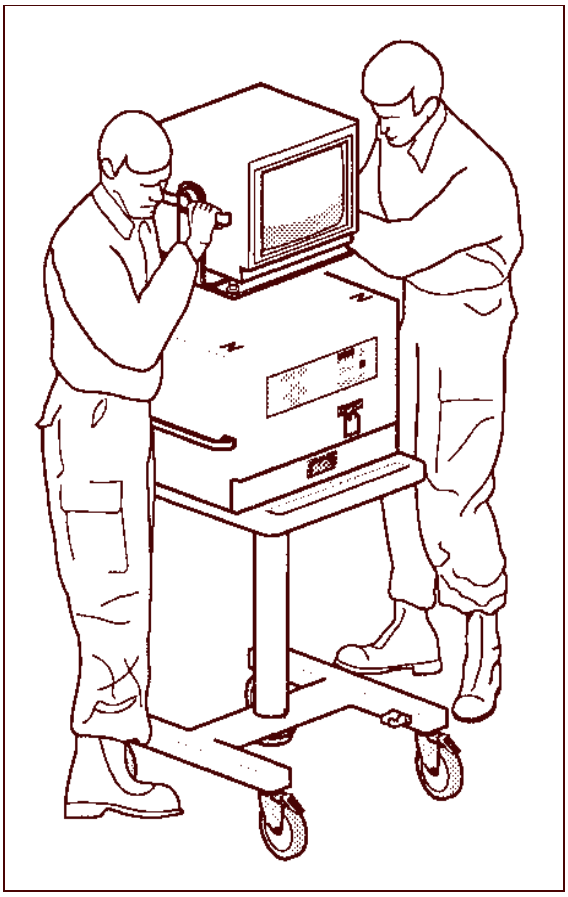


Fig. 79

9. The 4 fixing bolts (arrows) against the spring pressure press in and tighten.

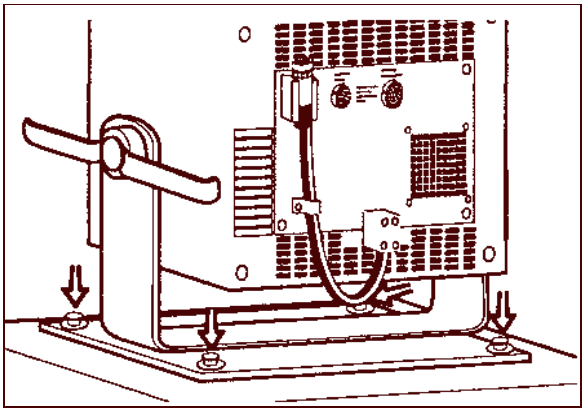


Fig. 80

10. Connecting cable on the back of the display unit from the mounting plate take out and put into the plug socket (monitor) at the bit map memory unit (red point at the plug upward). Wrap shell tighten.

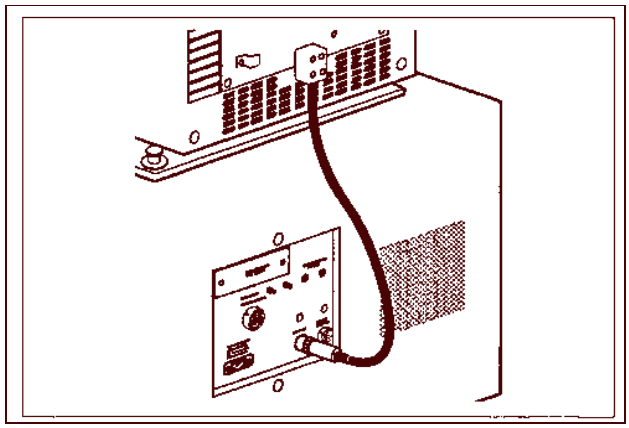


Fig. 81

11. Radiation indicators from the drawer of the bit map memory unit take out, put into the mounting plate on the back of the display unit. The locking spring of the plug press and put the plugs into the black sockets on the back of the bit map memory unit.

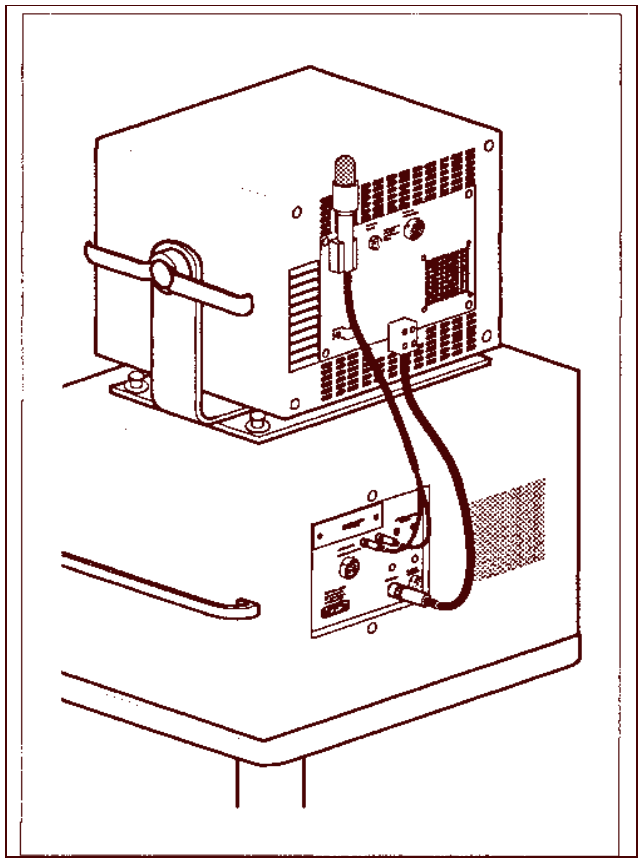


Fig. 82

12. In the bit map memory unit is placed the drawer with the radiation indicator, screwdriver and the expendable material.

REFERENCE

The gettertubus can be kept in the drawer.

CAUTION

The drawer flap can cause injuries when falling down. When opening the drawer the handle of the support plate do not touch (clamping danger).

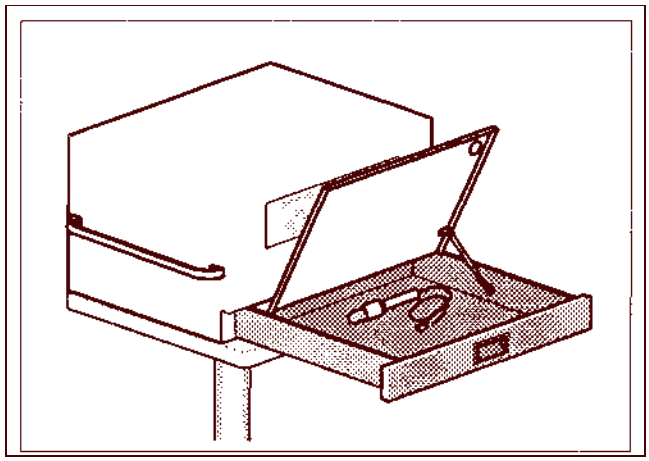


Fig. 83

2.2 Connection of the devices

2.2.1 Connection X - ray unit and display unit

1. X - ray unit and display unit bring and positioning to the place of work. The belts at the cable support loosen by pressing the buckle end down, take the complete mains connection line from the cable support and attaches to a plug socket with the connected load source 220 V AC 16 A.

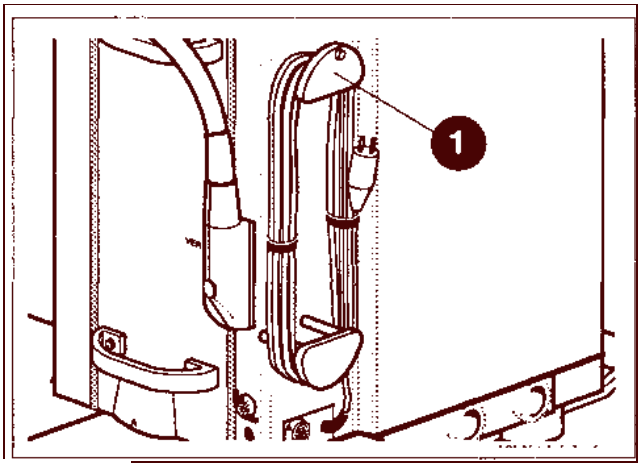


Fig. 84

2. The cable connection of the cable carrier complete remove and a plug (85/1) with the red point upward to the female connector at the electronics block set and with the wrap nut tighten.

3. If a potential equalization is to be made, is the potential equalization line to the electronics block to attach (see section 2.16.7)

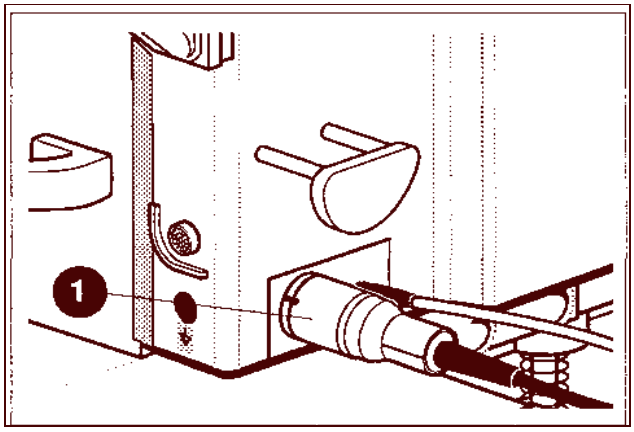


Fig. 85

4. Second plug of the cable connection with red point upward to the female connector at the bit map memory unit connect and tighten with the wrap nut.

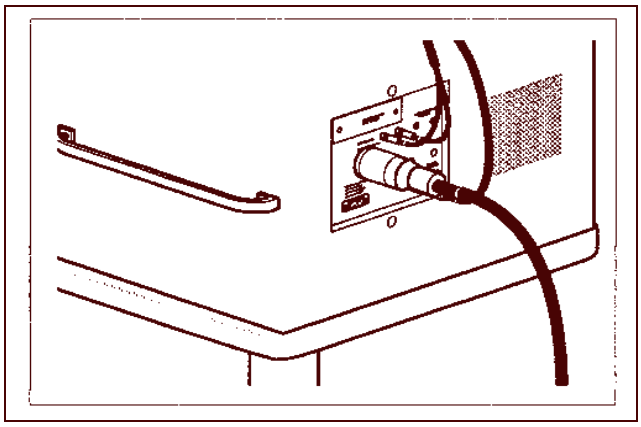


Fig. 86

5. Double foot switches from the container take out and the plug with the red point upward to the female connector at the electronics block connect and tighten with the wrap nut

REFERENCE

Is not used the double foot switch, is these into the mounting at the cable support (84/1) to be hung up.

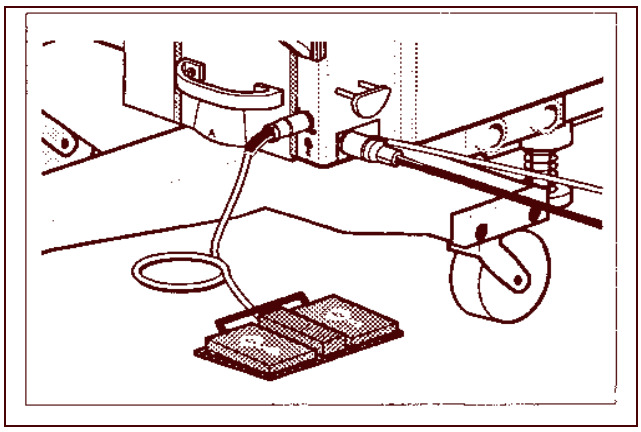


Fig. 87

6. The cable under the desk top would carry out and placed in the safety mounting plate on the trolley fasten.

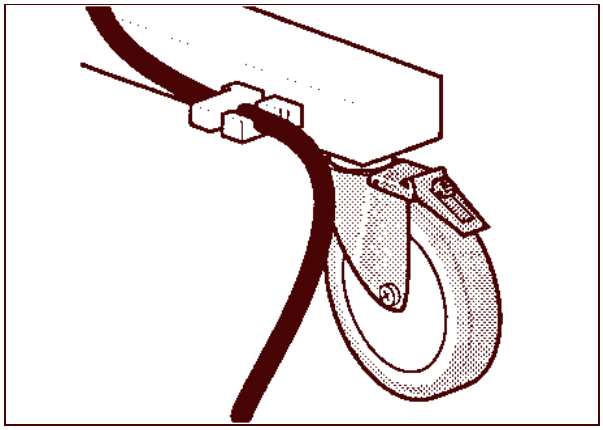


Fig. 88

2.2.2 Emergency operation

In case of failure of the bit map memory unit a fluoroscopy operation can be also without bit map memory unit only with attached display unit. Mains supply is made by the cable connection via the X - ray unit.
The bit map memory cable is connected to the plug socket (connection monitor) at the back side of display unit and the cable connection is attached by the X - ray unit directly at the display unit.

CAUTION

The radiation indicator is not connected in the emergency operation.

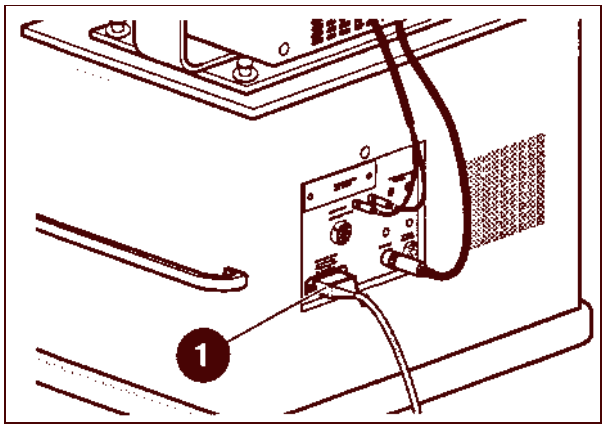


Fig. 89

2.2.3 Connection with independent operation of the display unit (without X - ray unit)

ɔlay terminal unit can be used as an stand alone unit for formatting of floppy disks or for the evaluation of stored fluoroscopy pictures on floppy disks.
ns connection cable of the carrier from the container 8/8 take out and put it into the socket (89/1) and connect with mains supply voltage 220V AC.

REFERENCE:

The only following functions are possible:

- Floppy Disk read
- Floppy Disk formatting
- Memory change
- Screen window insertion
- Brightness/contrast regulation
- Picture rotation

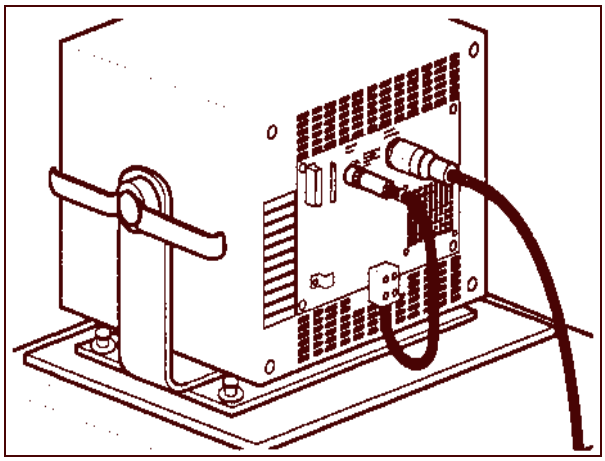


Fig. 90

2.3 Explanation of the individual control elements

2.3.1 Mechanical blocking/adjustment elements of the X - ray unit

The X - ray unit can be locked with the parking brake.

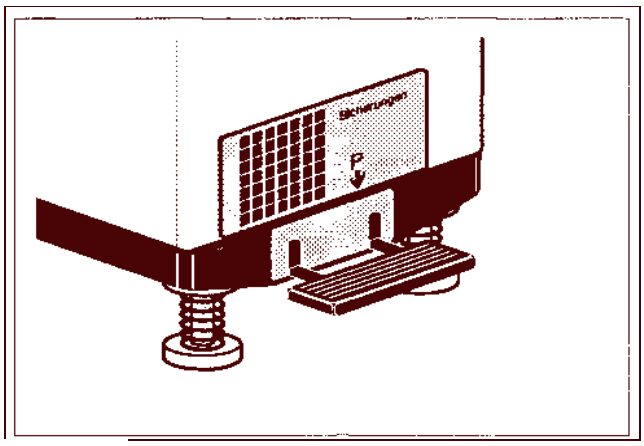


Fig. 91

If the X-ray source is to be turned, then the stop knob (92/1) is to be pulled out and determined (somewhat turn button). The X – ray source can be turned now after both sides. After swivelling the stop knob must engage again.

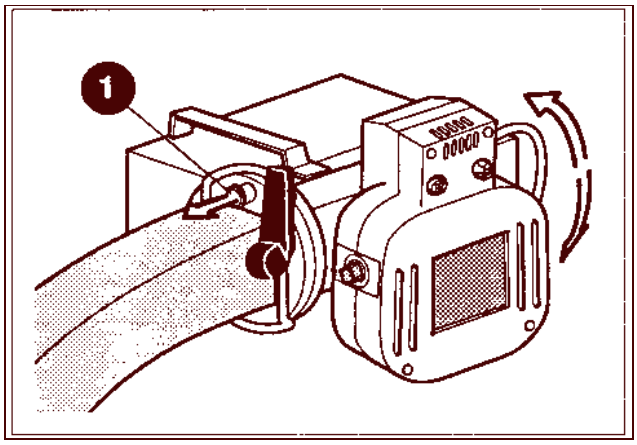


Fig. 92

Is to be displaced the X - ray unit, then it is pushed by the hand rails at the electronics block (93/1).

The lift movement of the C -arm success via motor drive. With switched on X - ray unit takes the control with the push-button (93/2) at the electronics block.

At the upper and lower limit position it comes to the automatic self off switching.

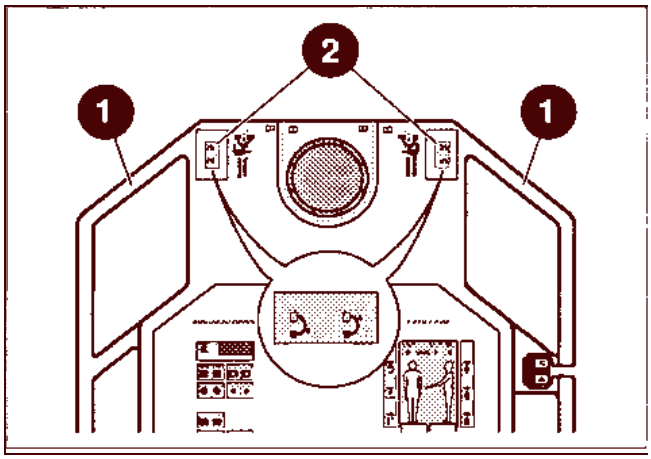


Fig. 93

If the stroke column is to be driven into the packing position, in addition the push button "packing" (94/1) at the stroke column and one of the push button "C - arm lowers" (93/2) it is to be pushed at the same time for driven down

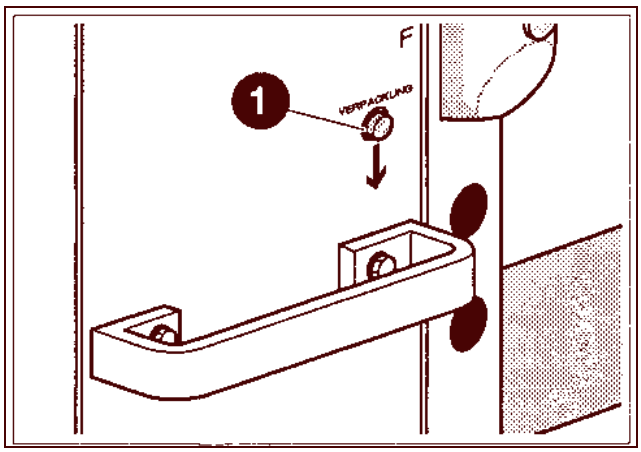


Fig. 94

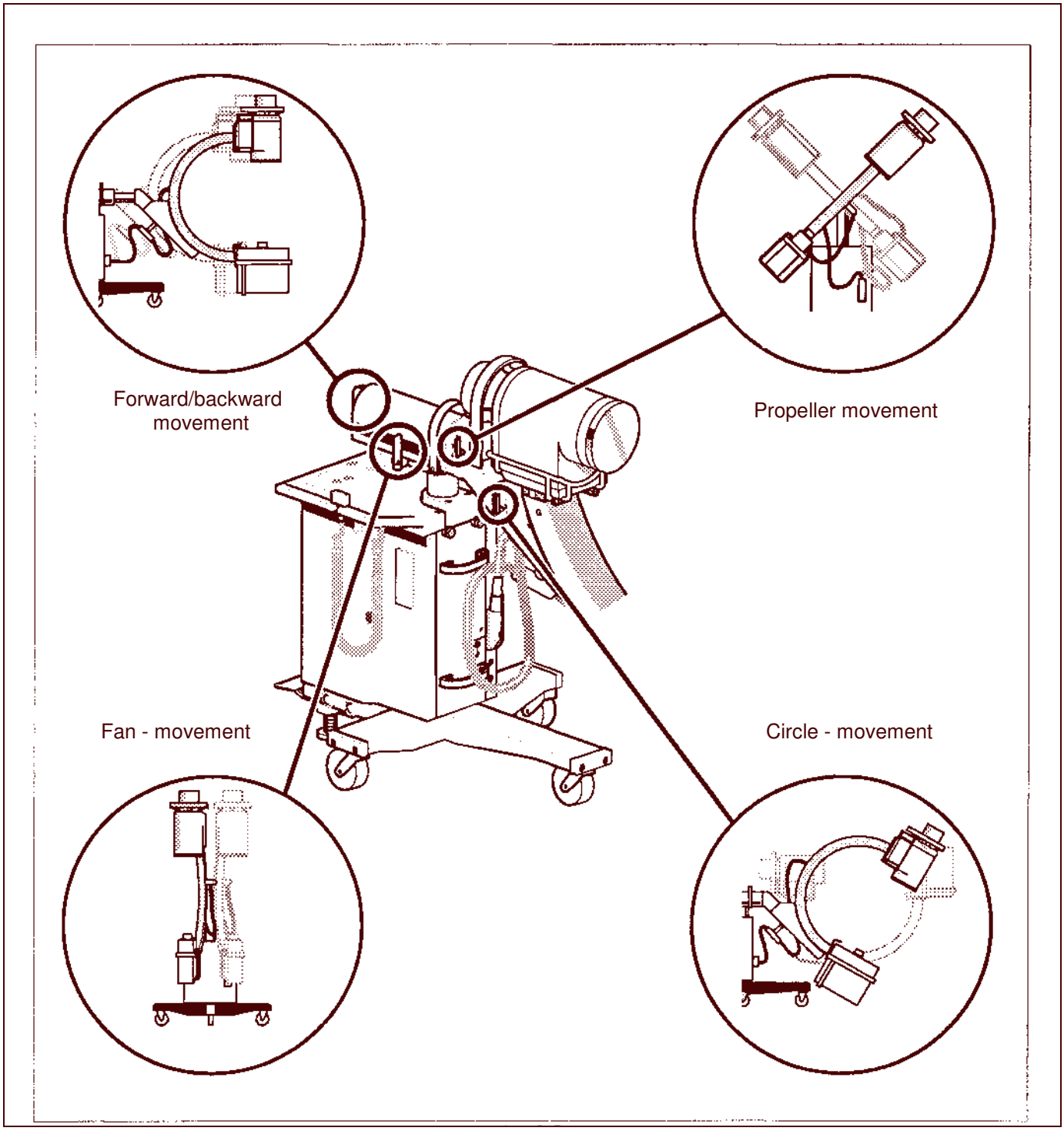


Fig.95:Control elements for the mechanical adjustment of the C –arm

2.3.2 Push buttons of the X - ray unit

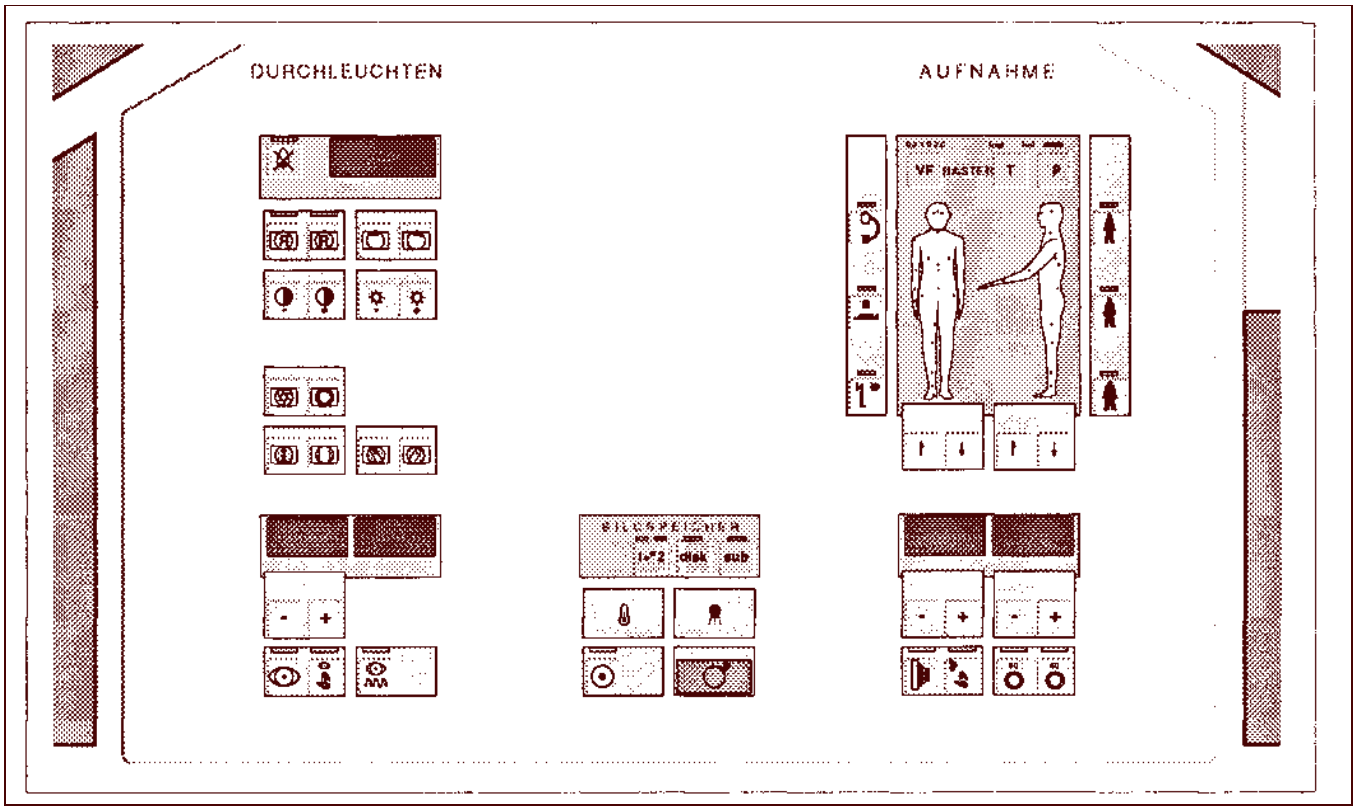


Fig. 96

The individual push buttons are on the constantly lit up control tablet (96) at the electronics block.

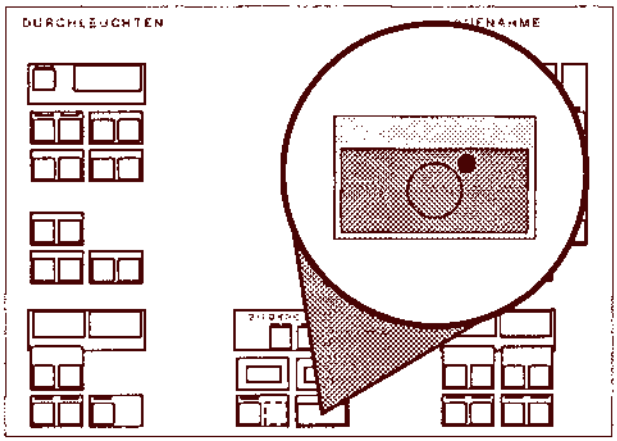


Fig. 97

OFF push button

Used for switching off the X - ray unit.
It is also used for the "EMERGENCY STOP " function.

ON push button

Used for switching on the X - ray unit If the equipment is switched on, the lamp over the push button shines.

If the lamp flashes, then a alarm message is present.

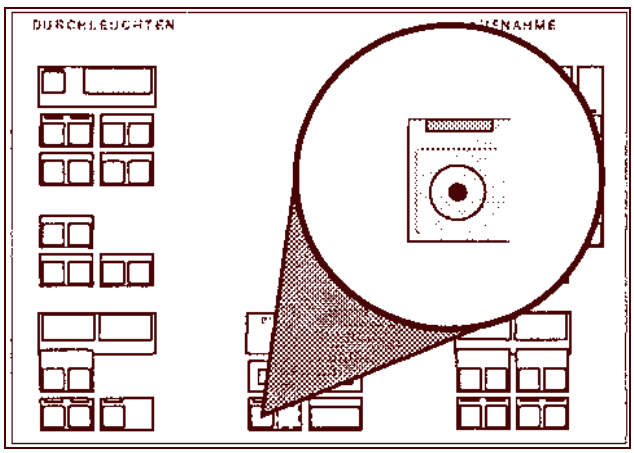


Fig. 98

Diagnostic push button

With available "not ready" - condition can be represented with the diagnostic push button the exact error code in the display for fluoroscopy time.

With "not ready" - messages the code is sequentially displayed.

With "alarm" - messages flashes the code automatically.

Approx.. 30 seconds after switching on should be all " not ready" - conditions deleted. Otherwise an error is present.

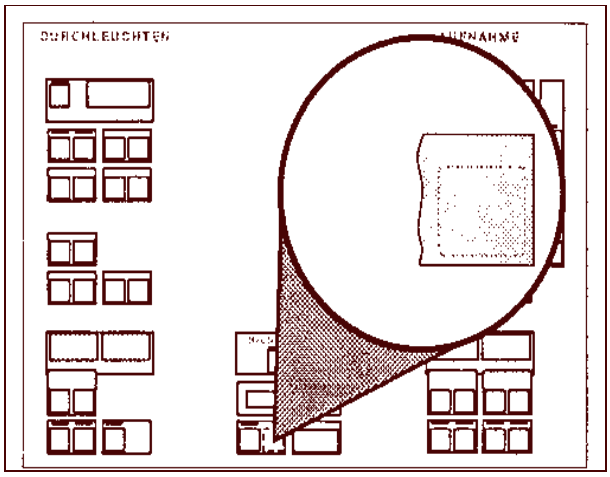


Fig. 99

REFERENCE

If "not ready" - or "alarm message are present no x-ray is possible, (see also 2.13).

Lamp test

By simultaneous pressing of the switching on push button as well as the surface (diagnostic push button), lying right beside the push button, a lamp and an indication area test are accomplished.
All lamps light up, and the numbers that as "1" or "8" represented.
In the display "fluoroscopy time" (119/2) appears the display "error 1-9".

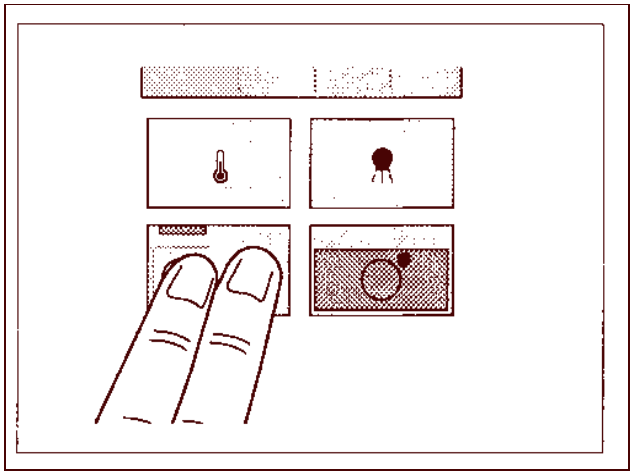


Fig. 100

Radiation indicator light

In the case of radiation this lamp shines

A second radiation indicator is at the rear wall of the display unit (see 2.1.4 assembly display unit).

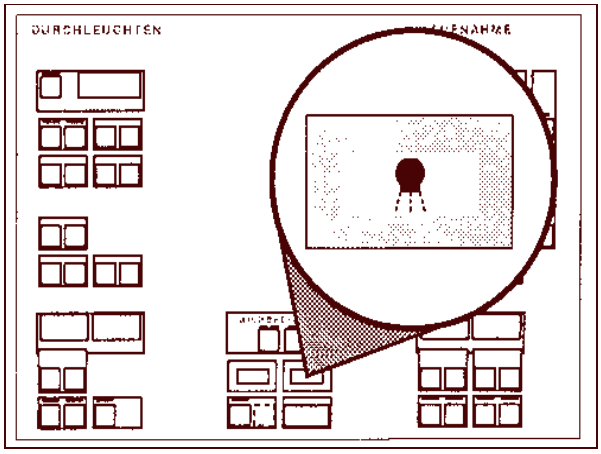


Fig. 101

Signal lamp X – ray source temperature

The lamp indicates a too high X – ray source temperature.
Temperature >50 °C lamp shines.
Temperature >70 °C lamp flashes.
Temperature >75 °C lamp flashes,
radiation is blocked, signal sounded during radiation release.

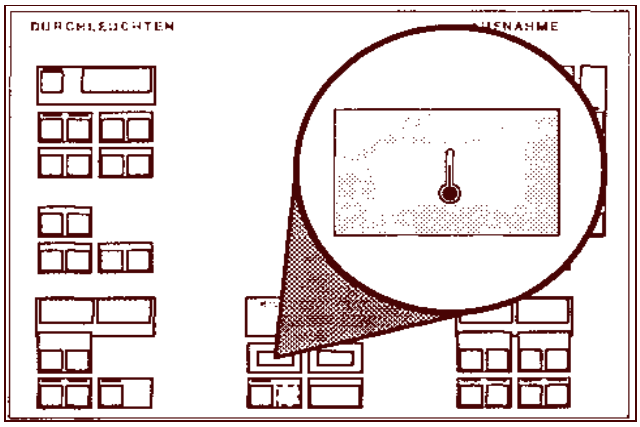


Fig. 102

Push button " Memory change "

It toggles between 1. Memory and 2. Memory. The selected memory is displayed over the push button, and memory picture are shown on the display unit.

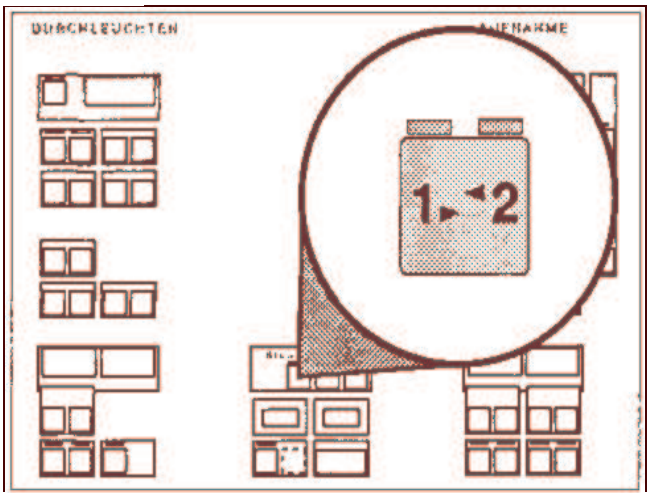


Fig. 103

Push button " Store "

Stores on the display unit represented picture on floppy disk.

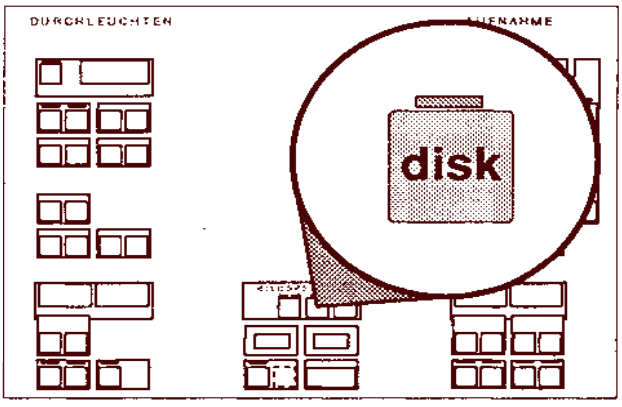


Fig. 104

Push button "Subtract " function

The picture of the activated memory (visible picture) is subtract from the picture of the not activated memory (background accumulator) and the result is represented on the screen from the display unit.

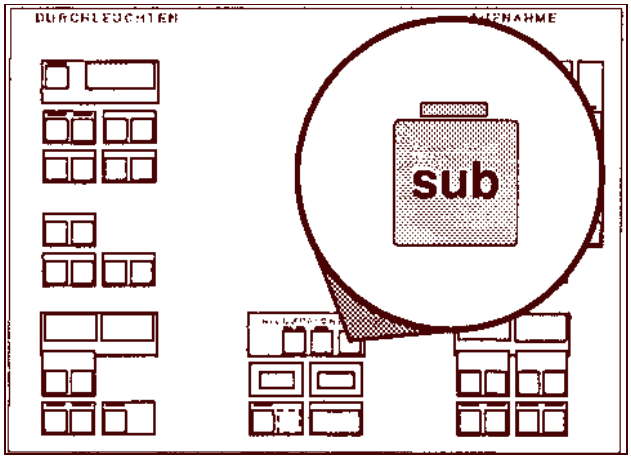


Fig. 105

Display fluoroscopy time

The fluoroscopy time (104/2) is displayed. After 5 min fluoroscopy sounds a warning signal and the lamp over that to resetting push button (104/1) shines. The warning signal is deleted short pressing of the resetting push button.

REFERENCE
Without confirmation the equipment switches after 10 min automatically off.

Time measurement is independent of this signal message. At the end of the examination the date is to be noted and attached to the patient data.
The data is to be reseted to "0"by longer pressing the push button.

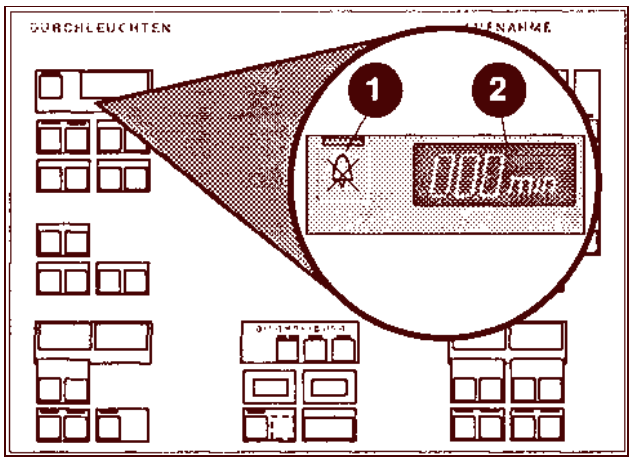


Fig. 106

Mirror reversal of the fluoroscopy picture

Left push button = mirror-reversal picture

Right push button = normal picture

The lamps above the push button displayed the selected image position.

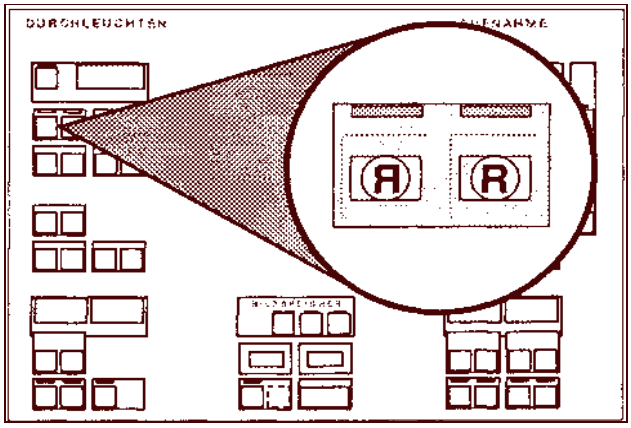


Fig. 107

Contrast of the fluoroscopy picture

Left push buttons = decrease contrast.
Right push buttons = increase contrast.

Both push buttons at the same time pressed, the desired value goes back to starting adjustment for the contrast and the brightness.

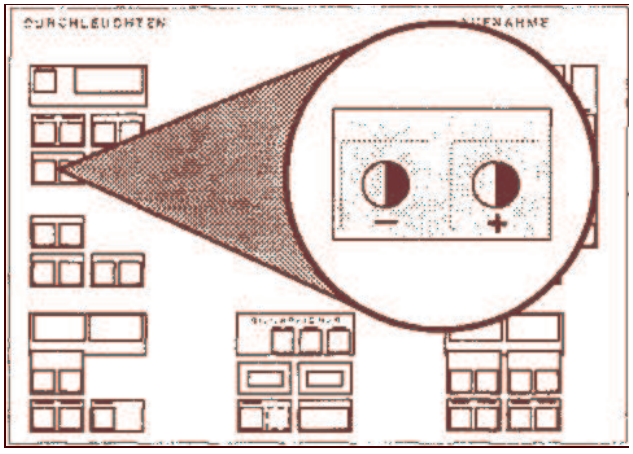


Fig. 108

Turning of the fluoroscopy picture

Left push buttons = turn in the counter clockwise direction.
Right push buttons = turn in the clockwise direction.

Both push buttons at the same time pressed, turned back the picture into the starting position.

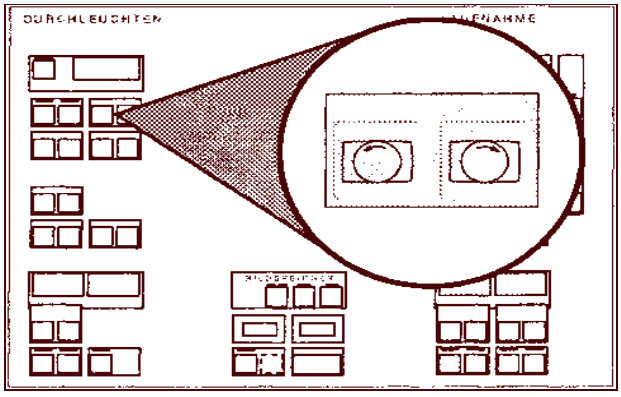


Fig. 109

Brightness of the fluoroscopy picture

Left push button = decrements brightness

Right push button = increments brightness

Both push buttons at the same time pressed, the desired value goes back to starting adjustment for the contrast and the brightness.

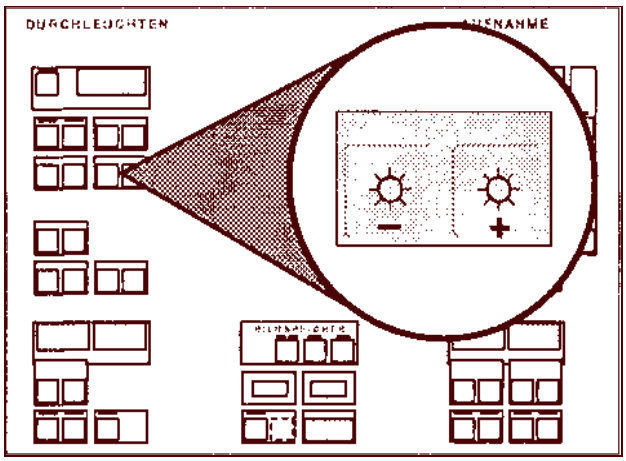


Fig. 110

Insertion with half transparency screen

Lateral insertion by half transparent screen..

Left push buttons = screen closed.

Right push buttons = screen open.

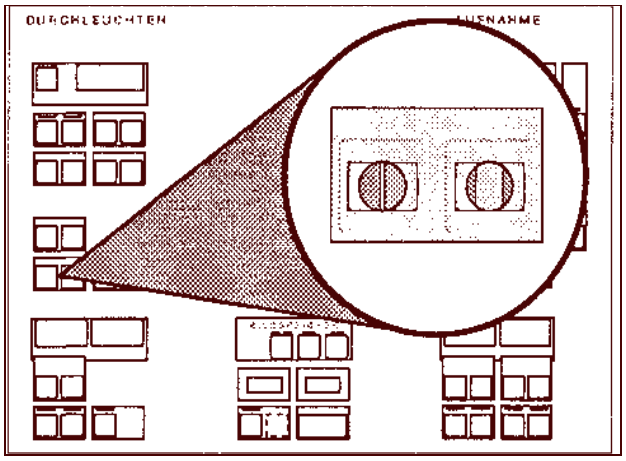


Fig. 111

Turning of the half transparency screen

Left push button = turn counter clockwise.

Right push button = turn clockwise.

The maximum angle of rotation amounts to 90°.

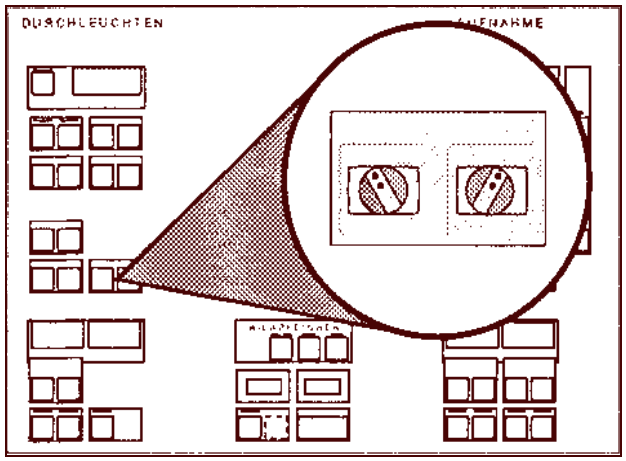


Fig. 112

Insertion with the iris screen

Screen insertion of the fluoroscopy picture with the iris screen = < 15 cm ϕ.

Left push buttons = iris screen closed.

Right push buttons = iris screen open.

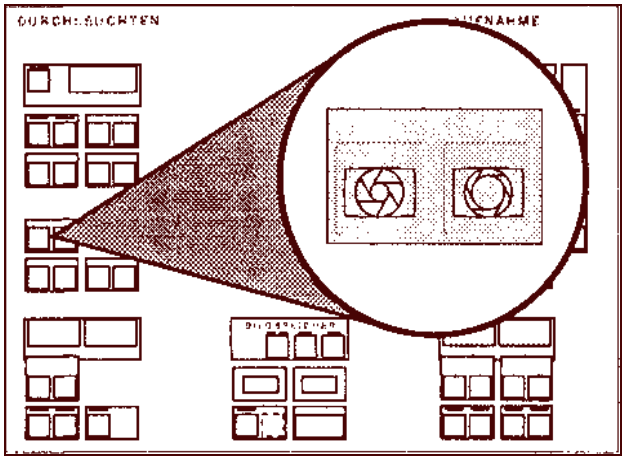


Fig. 113

Indication area of fluoroscopy values

The values kV and mA are indicated in the displays.
In the modes of operation with manual setting the KV values with the push buttons present below the display can be changed.

Left push button	=	decrease kV-value
right push buttons	=	increased kV-value

The mA-value is adapted automatically.

The data for snapshot are displayed only during the exposure (push button pressed).

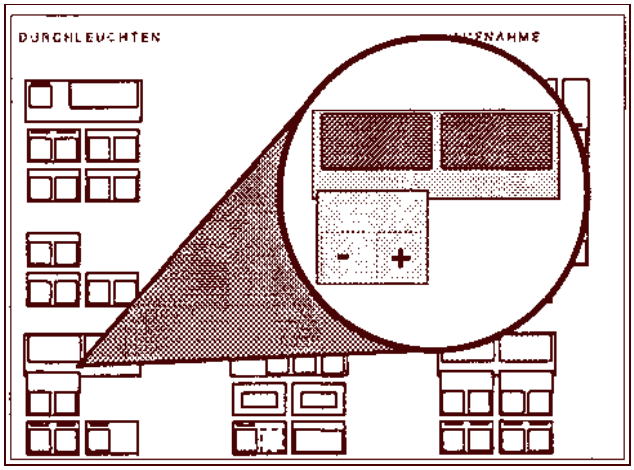


Fig. 114

Selector button Mode of operation

Left push buttons	=	fluoroscopy with automatic settings
Right push buttons	=	manual settings

The lamps above the push buttons displayed the selected mode of operation.
If manual setting is selected, both lamps are shining.

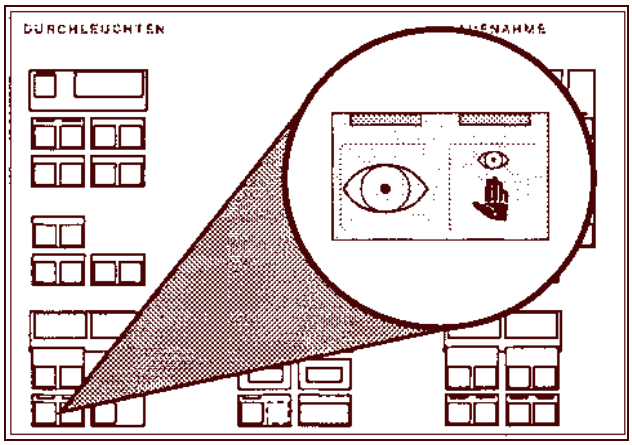


Fig. 115

Left push button	=	pulsed fluoroscopy

The lamp over the left push button displayed the selected mode of operation.

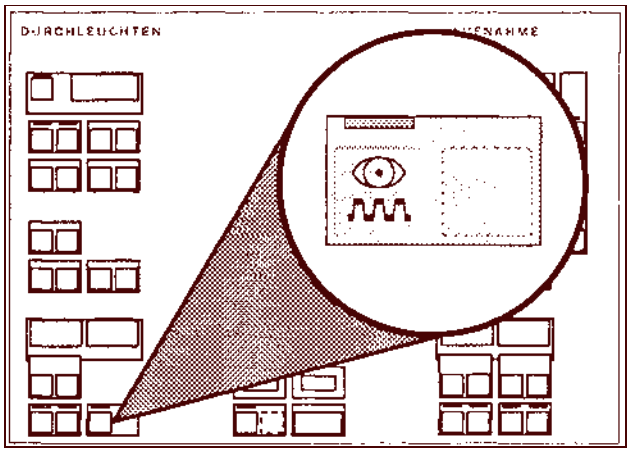


Fig. 116

Selector button “Aufnahme” it means “Radiography” operation

The radiography operation is selected with one of the three push buttons. The lamp over the pressed push button in each case shines.

Upper push button	=	exposure on cartridge holder at the image intensifier
Middle push button	=	exposure on X - ray table FFA = 100 cm (fixed)
Lower push button	=	exposure on cartridge stand FFA = 100 cm (fixed) (Lung pictures FFA = 150cm)

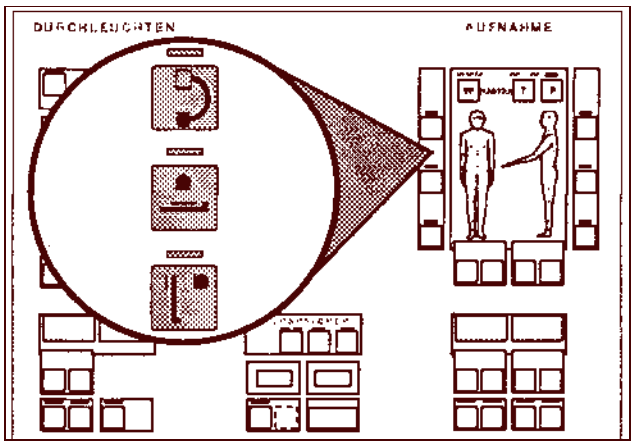


Fig. 117

Push button amplification foil (VF)

With the push button can be made a correction according to the used foil combination. The selected value in each case is displayed over the push button. The factor is switched by touching the push button lightly to 2,0, by renewed touching lightly to 0,5, 1.0 etc...

0,5 = sensivtyclass SE-100
1.0 = sensivtyclass SE-200
2.0 = sensivtyclass SE-400
according to DIN 6867 and IEC

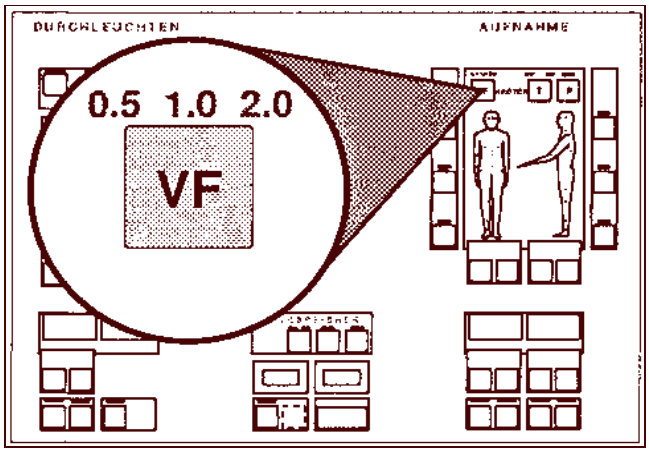


Fig. 118

ATTENTION

Resetting on factor 1.0 does not occur automatically during the radiography operation. The correction must be cancelled consciously again!

When switching on of the mode of operation "Radiography" automatically factor 1.0 is preset.

Push button fixed or free data

With the push button can be switched between the fixed and the freely programmed data. The signature freely (frei) or fixed (fest) shines over the push button and displayed thereby the selected mode of operation.

REFERENCE

After switching on the equipment is automatically preseted to "fixed data".

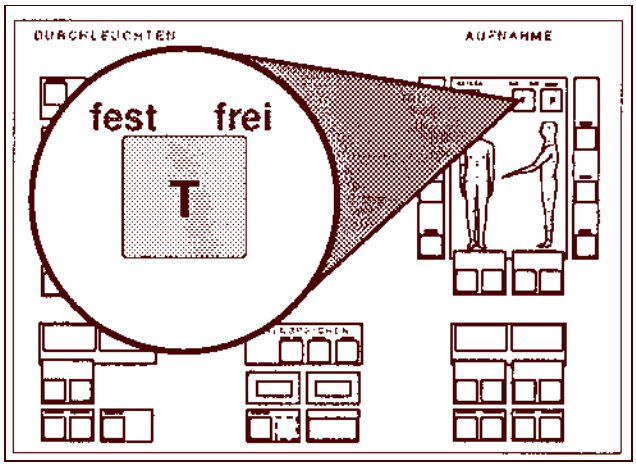


Fig. 119

Push button programming (P)

The push button it is used for the storing of free data into the program of the x-ray unit.
Push button once operate, data enter and push button again operate.
The lamp over the push button flashes for the time of programming.

ATTENTION

Push button "fixed/free data" must be positioned on free data. Existing (old data) free data are automatically deleted!

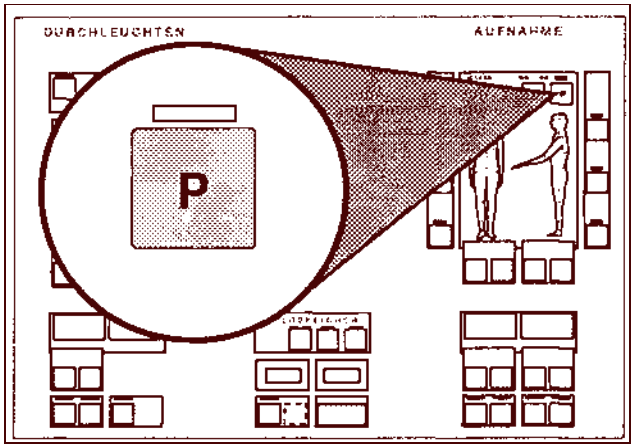


Fig. 120

Selector buttons patient-thickness-adapt

With one of the three push buttons the appropriate selection make.
The values referred to the patient are calculated by the program table and displayed in the display for kV and mAs values.

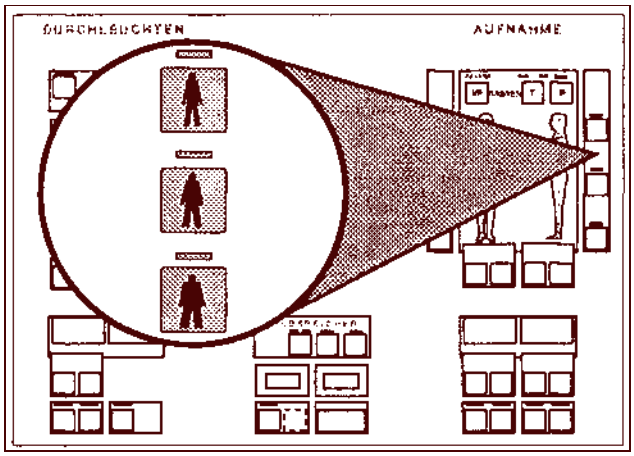


Fig. 121

Selector button patient range

For frontal and lateral exposures can be up and downward selected the range of exposure with the assigned push buttons. The selected range is optically displayed.

In order to arrive for the same range from the lateral into the frontal level (or in reverse), short touching is sufficient for one of the arrow push button.

Signature “ Raster”

The signature "RASTER" (122/1) shines, if according to program for certain exposure objects a raster cartridge or a raster (pit relationship 24/7) is to be used.

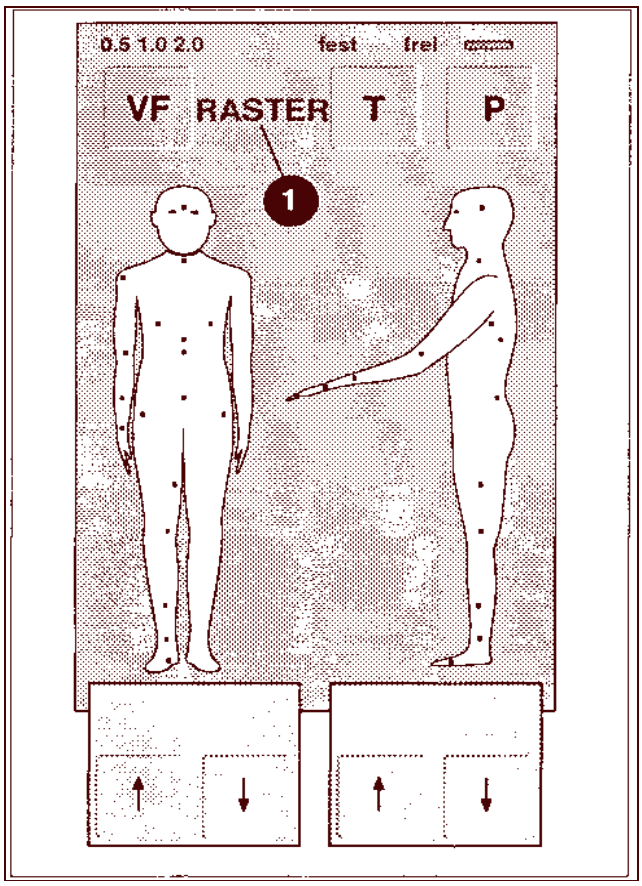


Fig. 122

kV value display

The KV values are displayed in the display area.
The value can be changed with the push buttons below the display.

Left push button	=	decrease KV value
Right push button	=	increase KV value

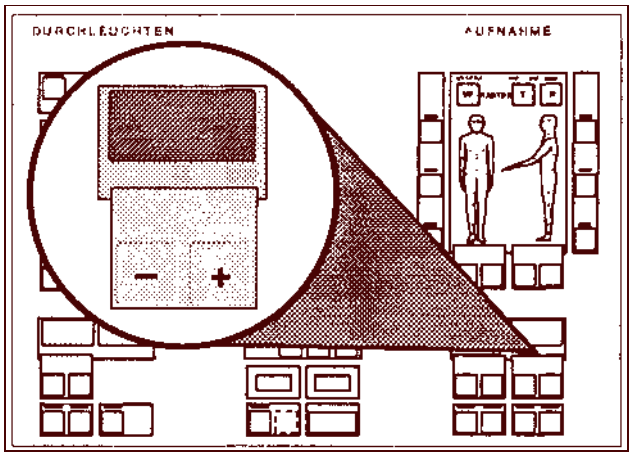


Fig. 123

mAs-value display

In the display area is displayed the adjusted mAs value.
The value can be changed with the push buttons below the display.

Left push button	=	decrease mAs value
Right push button	=	increase mAs value

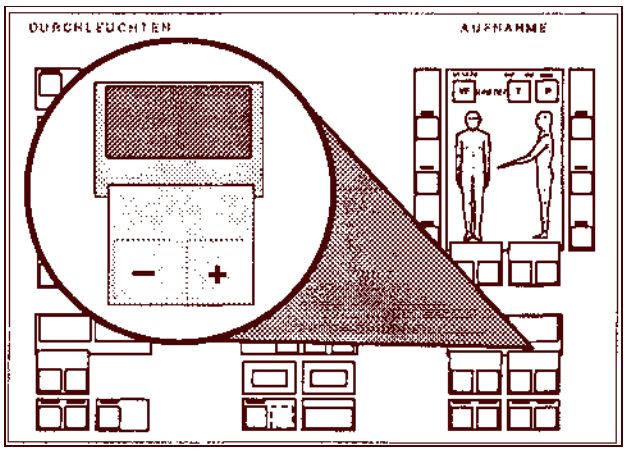


Fig. 124

Selector button radiography mode

With the push button can be switched between automatic or hand exposure.

Left push button	=	automatic exposure
Right push button	=	hand exposure

The lamps above the push button displayed the selected mode of operation. If hand exposure is selected, both lamps shine.

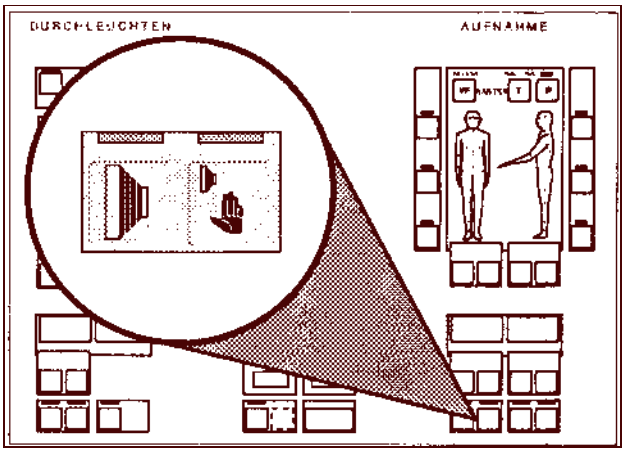


Fig. 125

Push button aperture setting

With exposure within the C - arm (fluoroscopy tubus installed) with cartridge is the screen 15 automatically adjusted.
The screen value can be changed with the push button.

Left push button	=	screen 30
Right push button	=	screen 40

The lamps above the push buttons displayed the selected screen.

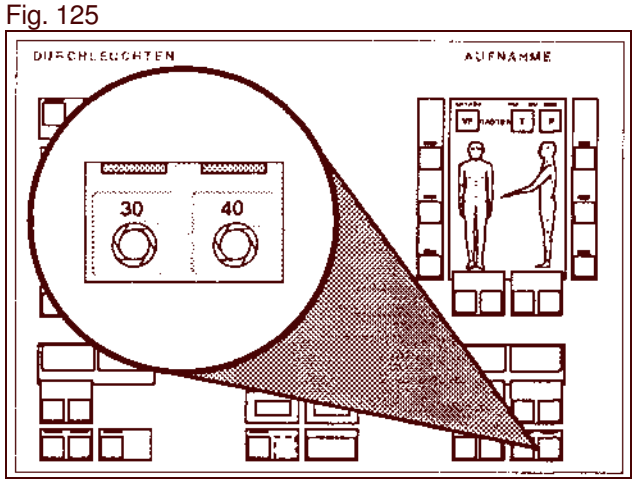


Fig. 126

2.3.3 Control elements collimator

Push button light

After pushing the push button the lamp of the collimators for approx 30 seconds shines.

Insertion

With the adjusting knobs (128/1) can be faded in the radiation field. Beside the buttons a scale is displayed as the FFA (FFD) corresponding the insertion for the desired cartridge format.

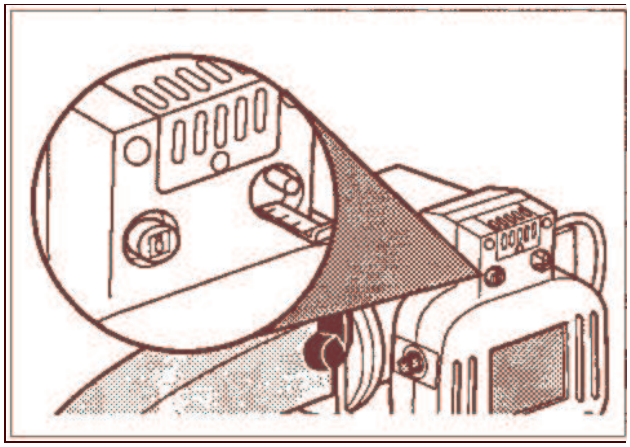


Fig. 127

Tape measure

The tape measure (128/2) serves for the determination of the focus film distance (FFD). The tape measure is equipped with an automatic fixing. The small button above the entrance opening (127) release the fixing mechanism.

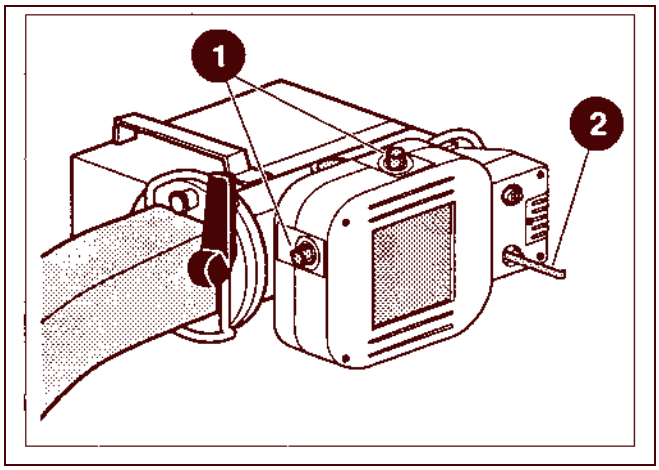


Fig. 128

2.3.4 Exposure modes

CAUTION
The maximally possible safety margin is to be always kept.

REFERENCE
After manipulation of the radiography push button (129/1) needs the x-ray unit a pre delay time from 0,8 s to the actual exposure release
.

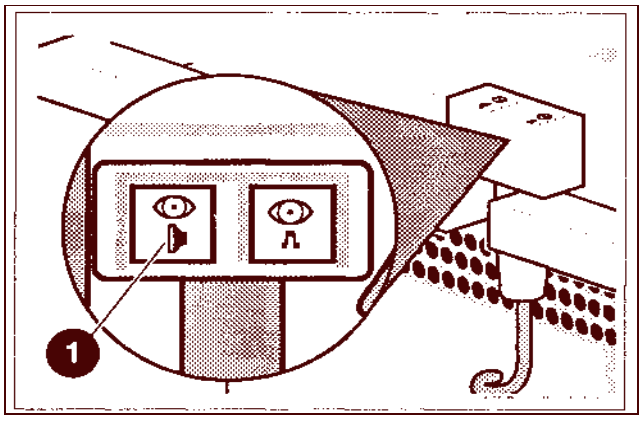


Fig. 129

2.3.4.1 Hand switch

The hand switch for release is to be served with thumb guidance designed and thus only from one side handle correctly.
It is equipped with a coiled cable for the bypass of the safety margins during exposure.

Left push button = exposure/fluoroscopy
Right push buttons = snapshot

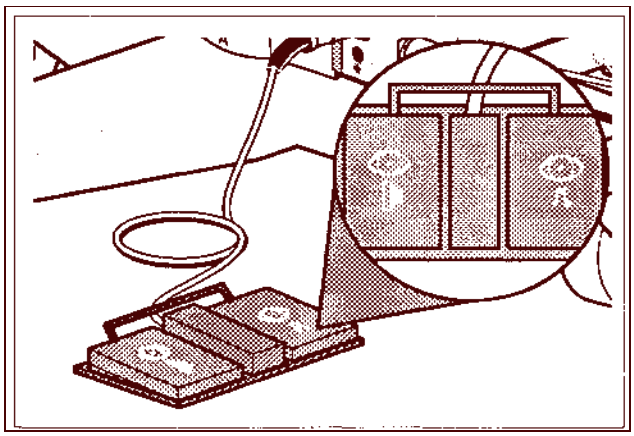


Fig. 130

2.3.4.2 Double foot switch

The double foot switches for release is to be served with a foot guidance equipped and thus only from one side handle correctly.
Left push button = fluoroscopy
Right push buttons = snapshot

2.3.5 Mechanical control elements of display unit

Parking brake of the trolley

Two wheels of the trolley are equipped with a parking brake.
The walk area (131/1) is used for the locking the brake.
By pressures of the surface (131/2) the brake is loosened.

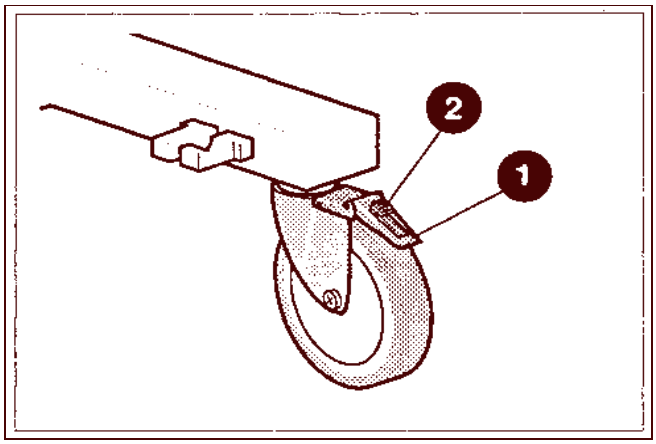


Fig131.

Floppy disc drive with eject button

The bit map memory unit is equipped with a floppy disk drive. The indicator light for drive assembly functions (130/1) is placed on left, the eject button (132/2) is placed right underneath the inserting slot.

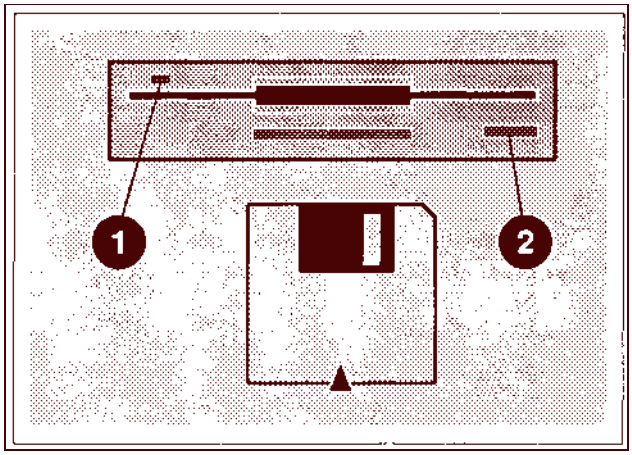


Fig. 132

2.3.6 Switches/push buttons bit map memory unit

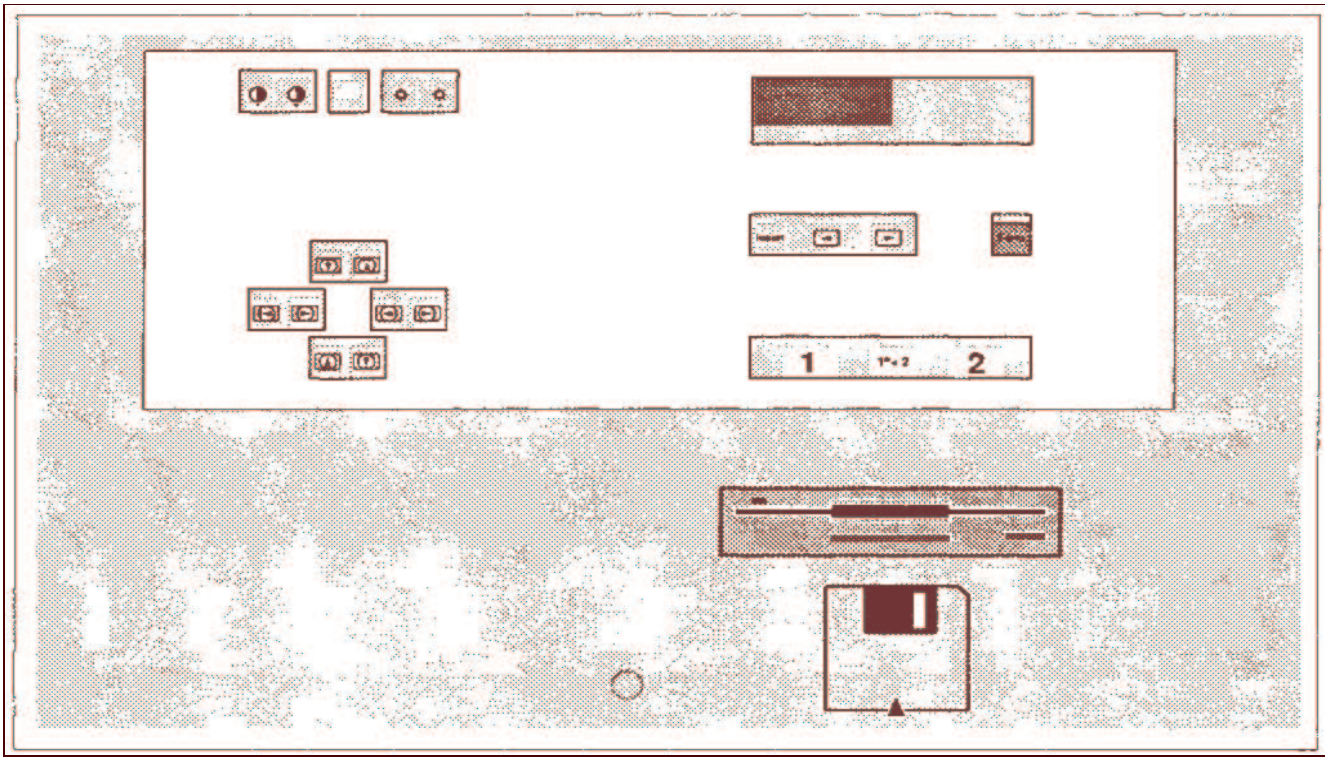


Fig. 133

Contrast of the fluoroscopy picture

Left push button = decrease contrast
Right push button = increase contrast

If both push button are pressed at the same time, the contrast and brightness value of the starting position are selected.

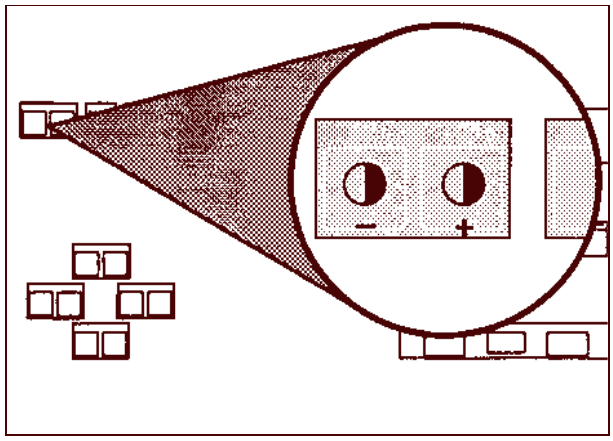


Fig. 134

Brightness of the fluoroscopy picture

Left push button = decrease brightness
Right push button = increase brightness

If both push button are pressed at the same time, the contrast and brightness value of the starting position are selected.

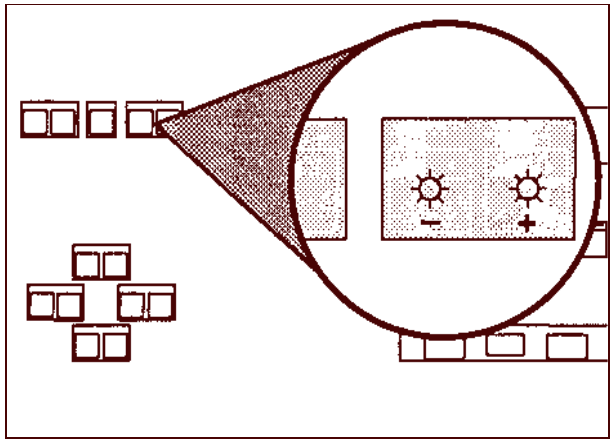


Fig. 135

Selector button screen window insertion

With the 4x2 push button can be faded in a stored picture independently of 4 sides.
Simultaneous pressing of two push button lying side by side lets the insertion go back again.

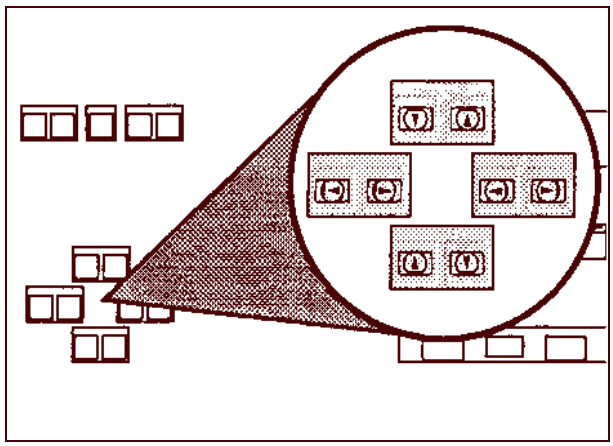


Fig. 136

Display picture number

When inserting a disk stands the counter on 0. The pictures are written in the order 1.2.3, 4, 5, 6 and displayed accordingly in the right half of the display.
In the left half during formatting from 79 to 00 counts down.
During reading pictures from 12 to 00 counts down.

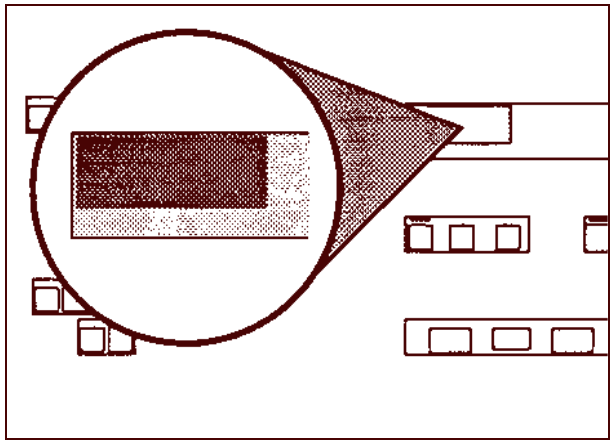


Fig. 137

Push buttons picture select

Left push button = decrements picture counter
Right push button = increments picture counter

The selected picture in the display “picture number” are displayed.

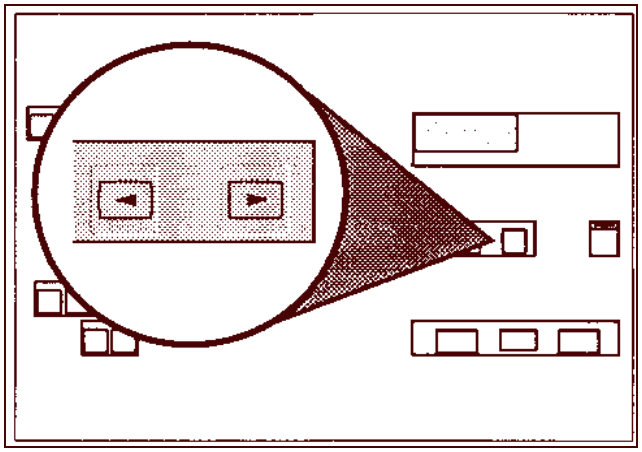


Fig. 138

Push buttons floppy disk read

The selected picture are reading and on the screen from display unit represented.

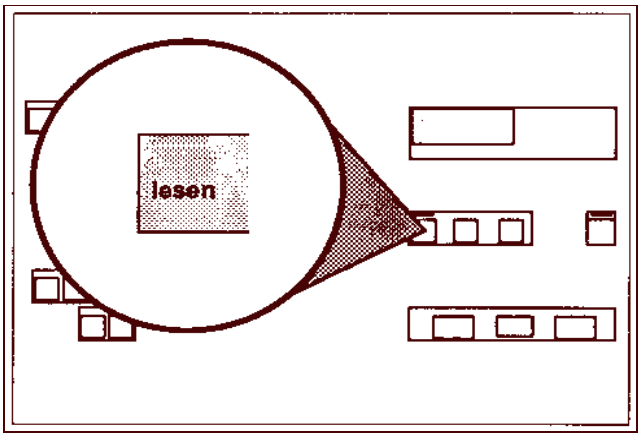


Fig. 139

Push button format

The push button starting the floppy disk formatting. During formatting the lamp shines above the key

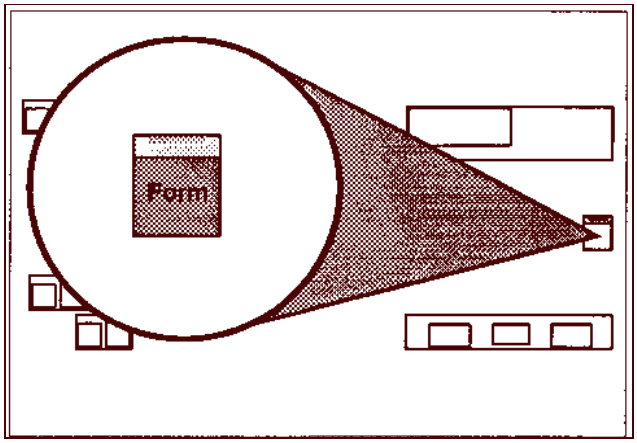


Fig. 140

Push button picture change

REFERENCE

This function can used only in stand alone operation of the display unit. In the fluoroscopy operation the picture change is accomplished by the control panel of the X ray unit.

By press of the push button the represented flouroscopy picture is stored into the background accumulator. At this time the picture in the background accumulator is represented. The displays beside the push button shine accordingly. Each press on the push button causes a renewed picture change.

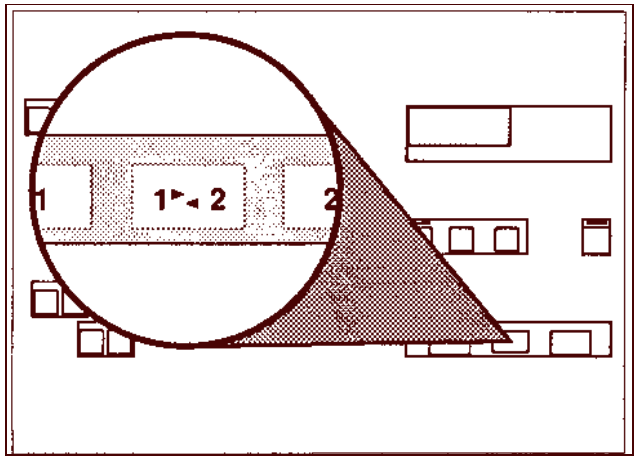


Fig. 141

2.3.7 Tester for fuses

On the back at the bit map memory is a test equipment for all equipment fuses, consisting of two lying exposed contact areas installed for the placing of the fuses and an display, (see also 2.13.1.2).

This test equipment works independent of mains

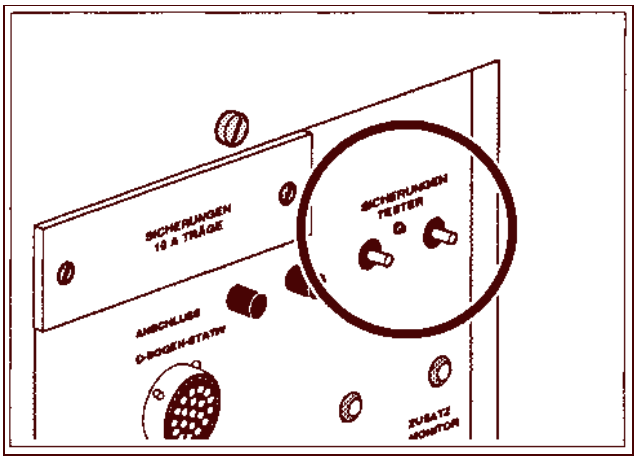


Fig. 142

2.3.8 Connectors bit map memory unit

The connections of the bit map memory unit are summarized on a plate at the back

1. Connection for the cable connection to the X - ray unit.
2. Connection for radiation indicator (display unit).
3. Fuse tester (see 2.3.7).
4. Connection for an additionally attached display unit.
5. Connection for the display unit.
6. Connection for mains.

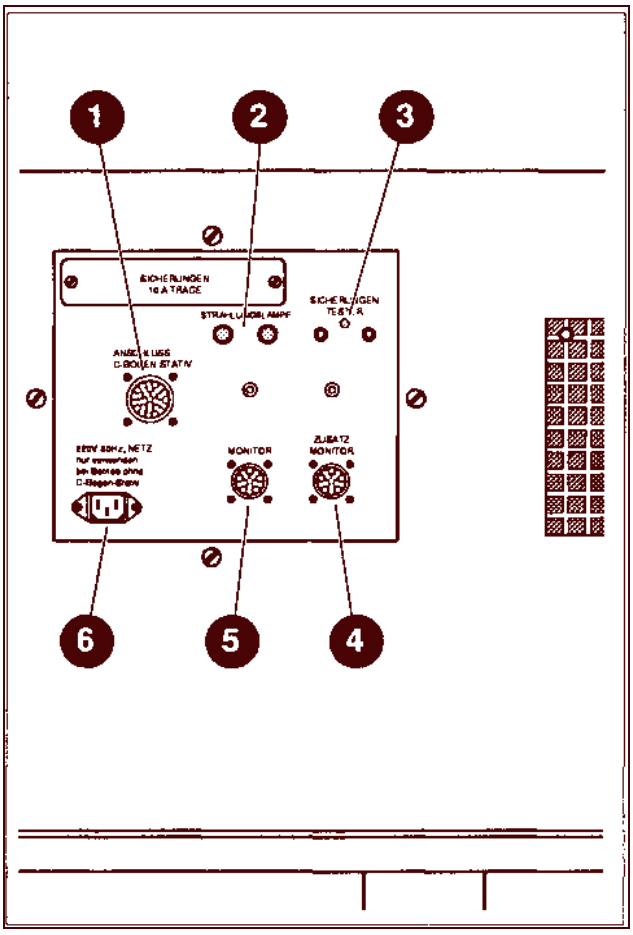


Fig. 143

2.3.9 Switch/push button display unit

On/Off switch display unit

The push button switches the display unit on and off.

The lamp in the push button shines when switched on the equipment.

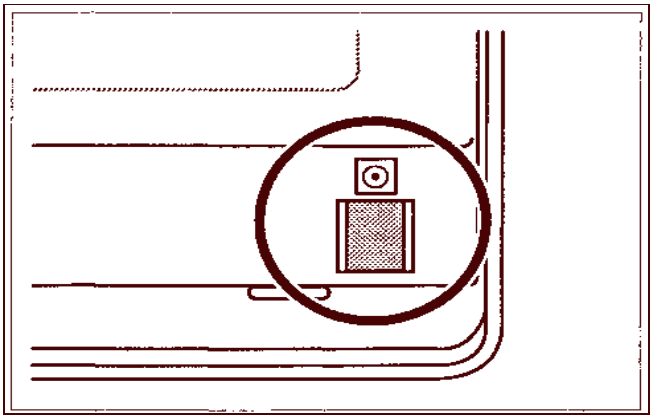


Fig. 144

Push buttons picture rotation

With the three push buttons leaves itself the picture rotation at the display unit accomplishes.

Left button	=	counter clockwise direction
Middle button	=	starting position
Right button	=	in the clockwise direction

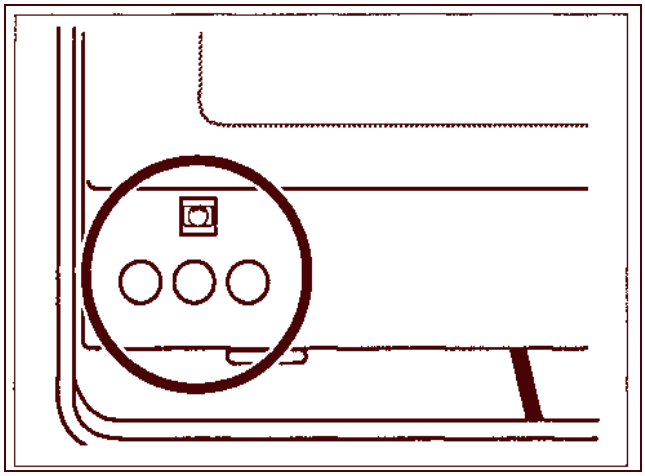


Fig. 145

Optical sensor for the brightness and contrast automatic

The sensor is behind the cover in the right housing corner.

REFERENCE
The sensor may be covered only to the function check briefly.

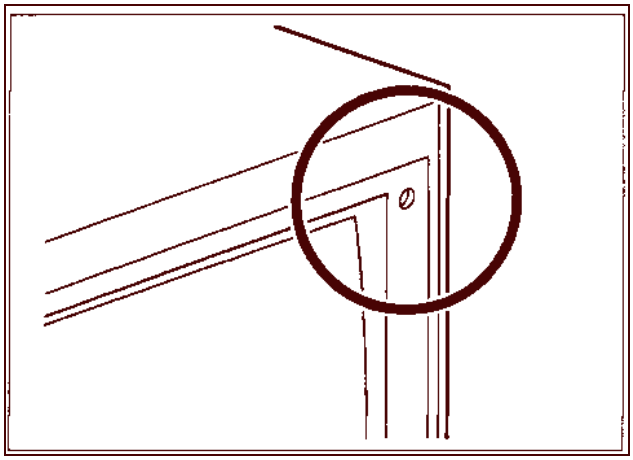


Fig. 146

2.3.10 Connectors display unit

The connections of the display unit are summarized on a plate at the back.

1. Connection for an additionally attached display unit. This connection is to be used only with the operation without bit map memory unit.
2. Connection for the connection cable to the X - ray unit.

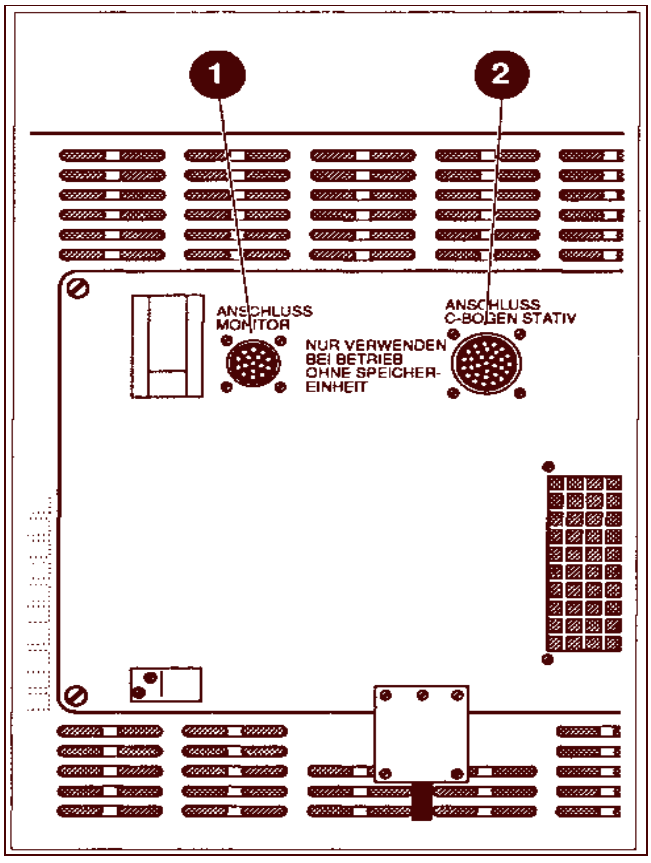


Fig. 147

2.4 System checks

The system checks is divided into:

- Visual inspection before using
- Mechanical system check
- Electrical system check
- System check of the **A**utomatic **D**ose rate **R**egulation (ADR)
- Functional test of the imaging/X - ray generating in the individual kinds of Flouroscopy/Radiography

REFERENCE

After each structure of the X-ray unit are to be accomplished view- and all system checks.

After each switching on of the x-ray unit the electrical system checks are to be accomplished.

2.4.1 Visual inspection before the use

REFERENCE Determined faults is to be repaired immediately.

- All connections of the components for tightness examine.
- Control whether all mechanical safety devices are in the prescribed position.
- All cable and connectors on outward damages examine.
- All parts on transport damages, depressions, tears or breaks examine.
- Surfaces of the units on damages of lacquer and scrapes examine.

2.4.2 Mechanical system check

REFERENCE Determined faults are to be repaired immediately.

Nr.	Activity	Result/Display
1	**Displaceable of the X - ray unit**	
1a	A the foot brake loosen and the X - ray unit at the hand rails into all directions muddled.	The X - ray unit must leave itself easily in all directions muddled..
1b	Foot brake fixed and try to shift the X - ray unit.	For shifting a substantial energy expenditure must be necessary.
2	**Vertical adjustment of the stroke column**	
2a	Stroke column with the right push button " C -arm lower" up to the self disconnection in the largest and lowest height drive.	No unusual running noise may have to be heard.
2b	Stroke column with the left Push button "C -arm lower" up to the self disconnection in the largest and lowest height drive.	No unusual running noise may have to be heard.
2c	Examining the barrier for "column lowest point" for packing. In addition "packing" and one of the push button " C -arm lower" press	The C -arm continues to itself lower.
3	**For- and backward movement of the C -arm**	
3a	Brake for for- and backward movement loosen and the C -arm move.	The C -arm can be moved easily.
3b	In the central position the brake tighten and try to shift the C -arm against the brake.	The brake must block the C -arm sufficiently.
4	**Fan movement of the C -arm**	
4a	Brake for fan movement loosen and the C -arm on the right and on the left move.	The C -arm can be moved easily.
4b	In the central position the brake tighten and try to move the C -arm against the brake.	The brake must block the C -arm sufficiently.
5	**Propeller movement of the C -arm**	
5a	A brake for propeller movement loosen and the C -arm in each case in the clockwise direction and the counter clockwise direction up to the stop turn.	The C -arm can be moved easily.

Nr	Activity	Result/Display
5b	Blocking stop (estimate safety device) loosen and the C - arm continue to turn. To the cable pay attention.	The C - arm can be moved further easily.
5c	In the central position the brake tighten and try to move the C - arm against the brake.	The brake must block the C - arm sufficiently.
6	**Circulation of the C - arms**	
6a	Brake for circulation loosen and the C - arm in image intensifier- and X – ray source direction several times as far as possible turn.	The C - arm can be moved easily. Initial running noise (caused by the flattening of the plastic roles) take off
6b	In the central position the brake tighten and try to move the C - arm against the brake.	The brake must block the C - arm sufficiently.
7	**Displaceable ness of the display unit**	
7a	Brake loosen and the display unit into all directions muddled.	The display unit must leave itself easily in all directions muddled.
7b	Brakes at the front wheels determine and try to shift the display unit.	For shifting a substantial energy expenditure must be necessary.

2.4.3 Electrical system check

REFERENCE After each switching on the electrical system checks are to be accomplished.

2.4.3.1 Electrical system check Display unit

Preparing work
- Cable connection X - ray unit - display terminal unit loosen
- Bit map memory mains connection line to electricity mains attach
- Test floppy disk (provides in accordance with 2.4.4.2) take up for test

Nr	Activity	Result/Display
1	Display unit switching “ON”	The lamp in the switch shine up. For the screen on are visible the bars for "memory picture".
2	Test floppy disk into the floppy disk drive push in.	The lamp at the drive assembly lights up briefly. Track 0 is displayed.
3	Successively the 6 pictures read in.	The selected picture is displayed and on the screen is the gradually turning screwdriver to be seen.
4	Picture 3 select and by pressing the push button "picture change" in the memory store.	On the screen only the two bars for memory picture are to be seen
5	Picture 1 select and by pressing of the push button "read" into the memory loads.	On the screen the picture 1 is represented.
6	By pressing of the "selector button screen window insertion" drive the electronic screens open and closed again.	On the screen the changed picture is represented.
7	Two "selector buttons screen window insertion" lying next to each other press at the same time..	The insertion is cancelled and the whole picture is again represented immediately.
8	Push button "picture changes" several times press	On the screen the picture of the screwdriver must be represented after each push button pressure around 90° turned.
9	The picture brightness with the appropriate push button in such a way adjust that the screen is completely bright or completely dark.	On the screen the changed picture is represented.
10	Both push button for brightness setting presses at the same time.	The picture brightness adjusts itself automatically according to the room lighting. The brightness of the picture on the display unit is optimally adjusted.

Nr.	Activity	Result/Display
11	The image contrast with the appropriate push button in such a way adjust that both possible final values are reached.	On the screen the changed picture is represented.
12	Both push button for contrast setting press at the same time.	The image contrast adjusts itself automatically according to the room lighting. The contrast of the picture on the display unit is optimally adjusted.
13	Sensor in the right upper corner of the display unit briefly with the hand cover.	The picture becomes somewhat darker and the contrast decreases.
14	At the display unit the push button for picture rotation in the clockwise direction (right button) press to the picture for instance on the head stands.	The picture is rotated in the clockwise direction.
15	At the display unit the push button for picture rotation in the counter clockwise direction (left button) to press and the picture somewhat turn back leave.	The picture is rotated counter clockwise direction.
16	At the display unit the push button for picture position resetting (middle button) press.	The picture goes back into the normal position.
17	Floppy disk take out of the floppy drive assembly, Floppy disk secure and again insert.	
18	Press the push button "Format" at the bit map memory unit.	Lamp over the push button flashes and on the screen appears the signature "BESTÄTIGE FORMATIEREN" it means “confirms formatting”
19	Push button "Format" press again	The audio signal sounded and the signature "DISKETTE GESICHERT" it means “disk secured” appear on the screen.
20	Eject button press, floppy disk however do not take out. Push button "Lesen" it means “read” press	Signal sounded and on the screen appear the message "DISKETTE EINLEGEN" it means “insert disk”.
21	Floppy disk take out, release write protection and insert again.	
22	Press the push button "Format" at the bit map memory unit.	Lamp over the push button flashes and on the screen appears the signature "BESTÄTIGE FORMATIEREN" it means “confirms formatting”.
23	Push button "Format" press again	The acoustic signal again sounded after conclusion of the formatting procedure. Error messages are represented on the screen.
24	Eject button press, take out floppy disk.	

2.4.3.2 Electrical system check Electronic unit.

Preparing work
- Cable connection X - ray unit - display unit attach
- Disconnect bit map memory from mains
- Fluoroscopy tubus install
- X-ray source in fluoroscopy position

Nr	Activity	Result/Display
1	X ray unit and display unit switch on.	The lamps over the push button/switches shine up. The screen must be visible the two bars of "memory picture".
2	Push button "Automatic exposure" press.	The lamp over the push button and the lamp over the selector button "exposure with cartridge holder" shine
3	Push button "exposure on operation table" presses.	Change-over is not possible.
4	Push button "admission on cartridge stand" press.	Change-over is not possible.
5	With the selector buttons "patient range frontal exposure" all positions select	The appropriate display shines. Exception: Display "lungs" does not shine.
6	With the selector buttons "patient range frontal exposure" the head select.	The display for the range "head" shines
7	Push button "normal humans" in patient-thickness-adapt press	The lamp over the push button shines. In the kV display must be the value..... stand. In the mAs display must be the value ..... stand.
8	Push button " foil sensivity " press to factor 0.5 are displayed.	The push button over the display 0.5 shines
9	With the selector buttons "patient range lateral exposure" all positions select.	The appropriate display shines. Exception: Display "lung" does not shine.
10	With the selector buttons "patient range lateral exposure" the head select.	The display for the range "head" shines.
11	Push button "thin humans" in patient-thickness-adapt press.	The lamp over the push button shines. In the kV display must be the value .... stand. In the mAs display must be the value . stand.

Nr	Activity	Result/Display
12	Remove the fluoroscopy tubus and install the collimator Swing out X-ray source from the C-arm plane.	Lamp "exposure on X -ray table" shine. The signature "RASTER" shines.
13	Push button "fluoroscopy automatic" press.	Change-over on fluoroscopy not possible. It remains "exposure" selected.
14	With the selector button " patient range frontal and lateral exposure “ select all positions.	The appropriate display shines. The indicator light "lung" does not shine.
15	Patient range "knee laterally" select.	The display "knee laterally" shines.
16	Push button "film/foil correction" press to factor 2.0 are displayed.	The display "2.0" over the push button shines.
17	Push button "thick humans" in patient-thickness-adapt press.	The lamp over the push button shines. In the kV display must be the value ..... stand. In the mAs display must be the value ..... stand.
18	Push button "stand exposure" press.	The lamp over the push button shines. The display "knee laterally" must expire.
19	With the selector button " patient range frontal and lateral exposure “ select all positions.	The displays for the extremities may not be shine.
20	Individual exposure values programming. With the push button "free/fixed data" the kind of radiography "free setting" select.	The lamp over the push button shines.
21	The push button "programming" press.	The lamp over the push button flashes.
22	Make patient settings and new values for kV and mAs setting.	The new values will be displayed
23	The entered data and the selected patient settings examine and if necessary change the data. For this patient settings (old) existing data get overwrite. Push button "programming" to press.	The lamp over the push button expires, the programming process is finished.
24	The light at the collimator switch on.	The light and the lamp in the switch shine for approx.. 30 s.

Nr	Activity	Result/Display
25	The tape measure at the collimator approx.. 150 cm take off and locking.	The tape measure remains taken off.
26	The tape measure keep easy and loosen the clamp.	The tape measure roll up.
27	Remove the collimator and the Dentaltubus install The mAs value only can be switched between 0,2 and 12	It becomes the KV value 60 displayed Display .....

2.4.4 Electrical system check with generating of X-ray's

System checks with x- ray production may be accomplished only by persons, who have appropriate the state of training and knowledge in the radiation protection.

- Briefing in up and dismantling of the x-ray unit.
- Operation and handling of the x-ray unit.
- Knowledge in the radiation protection (RöV).
- May not be past the last instruction longer than 1/2 year.
- The responsible health physics officer must have been informed before in time and personally, if it concerns a x-ray unit which is not constantly operated. Only with agreement of the health physics officer x-rays may be produced.
- A "operational controlled area" must have been furnished and marked.

ATTENTION For each execution of the system check, with x-ray production, must be guaranteed that burn in of the x-ray unit, is past not longer than 2 years or constant the equipment be at work!

Burn in or the system check with x-ray production replaces not controls of the Constants examinations prescribed after § 16 RöV, but can with the system check recognized fault the reason for the fact be that a x-ray unit no more may not be used to X – ray examination of living humans, before these damage (errors) is not repaired!

X-ray may be applied to living humans only in practice of the medicine (§24 RöV). For the examination of a X – ray system the use of the living human body is inadmissible as inspection item - e.g. flouroscopy or exposure of a hand it is absolutely not allowed!

CAUTION During the complete time of the system check may not be an unauthorized person more near than 5 m at the X-ray source staying. All persons of the operating and maintenance staff wear a complete body apron with a lead equivalent value of 0.35 mm of Pb and hold during entire switch-on time a distance from at least 2.5 m

2.4.4.1 Function test of the automatic dose rate regulation

Preparing work
- X - ray unit adjusted to flouroscopy
- Gettertubus is installed
- The X-ray source is directed toward the soil
- Double foot switch is attached

Nr.	Activity	Result/Display
1	X - ray unit and display unit switched on.	Lamps over the push button/switches shines. On the screen must be visible the two bars of "memory picture".
2	Push button "automatic fluoroscopy" press.	The lamp over the push button shines. In the display for the fluoroscopy data the values 40 kV and 0.1 mA are displayed.

Nr	Activity	Result / Display
3	Fluoroscopy with the double foot switch release and the display for fluoroscopy data observe	The radiation indicators shine and the signal sounded. The KV value in the display must be change within shortest time to 105 kV.
4	On fluoroscopy with manual settings switch and the KV value set to 40 kV	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
5	Push button "automatic fluoroscopy" press.	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
6	Fluoroscopy with the hand switch release and the display for fluoroscopy data observe	The radiation indicators shine and the signal sounded. The KV value in the display must be change within shortest time to 105 kV.
7	On fluoroscopy with manual settings switch and the KV value set to 40 kV.	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
8	Push button "automatic fluoroscopy pulses" press.	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
9	Fluoroscopy with the hand switch release and the display for fluoroscopy data observe	The radiation indicators shine and the signal sounded. The KV value in the display must be change within shortest time to 105 kV.
10	On fluoroscopy with manual settings switch and the KV value set to 40 kV	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
11	Push button "automatic fluoroscopy" press.	The lamps over the push button shines. On the display for fluoroscopy data the values become 40 kV and 0.1 mA displayed.
12	Snapshot with the double foot switch releases and the display for fluoroscopy data observe.	The radiation indicators shine and the signal sounded. The KV value in the display must be change within shortest time to 105 kV.

2.4.4.2 Function test of the imaging in the individual kinds of flouroscopy

Preparing work

- X-ray unit adjusted to flouroscopy with automatic setting.
- Flouroscopy tubus is installed.
- The X-ray source is directed toward the image intensifier and to the soil.
- A screwdriver (drawer bit map memory unit) lies as object on the image intensifier (on the drawn line).

Nr	Activity	Result/Display
1	With the hand switch the flouroscopy release.	The radiation indicator shine, the acoustic signal sounded. On the screen the shade picture of the screwdriver is to be seen clear.
2	During the flouroscopy to the other kinds of flouroscopy switching.	On the screen the shade picture of the screwdriver without memory sign (bars) to be seen clear.
3	Snapshot with the hand switch release.	On the screen the shade picture of the screwdriver without memory sign (bars) to be seen clear.
4	With the double foot switch the flouroscopy release.	The radiation indicator shine, the acoustic signal sounded. On the screen the shade picture of the screwdriver is to be seen clear.
5	During the flouroscopy to the other kinds of flouroscopy switching.	On the screen the shade picture of the screwdriver without memory sign (bars) to be seen clear.
6	Snapshot with the double foot switch release.	On the screen the shade picture of the screwdriver without memory sign (bars) to be seen clear.
7	Push button "flouroscopy with manual setting” press.	The lamps over the push button shine.
8	The KV value to 40 kV adjust.	On the Display 40 kV is displayed.
9	With the double foot switch the flouroscopy release.	On the screen the shade picture of the screwdriver is to be seen.
10	While the flouroscopy with the adequate push buttons the iris screen to close gradually and open again.	Cut-out of the flouroscopy picture must be step by step become smaller and back again to the original size.
11	Push button "flouroscopy with manual setting” press.	The lamps over the push button shines.
12	The KV value to 40 kV adjust.	On the Display 40 kV is displayed.

Nr	Activity	Result / Display
13	Fluoroscopy with the double foot switch release.	On the screen the shade picture of the screwdriver is to be seen.
14	While the flouroscopy with the adequate push buttons the half transparency diaphragm to close gradually and open again.	Cut-out of the flouroscopy picture must be step by step become lateral closer and back again to the original size.
15	Push button "flouroscopy with manual setting" press.	The lamps over the push button shines.
16	The KV value to 40 kV adjust.	On the Display 40 kV is displayed.
17	Fluoroscopy with the double foot switch release.	On the screen the shade picture of the screwdriver is to be seen.
18	While the flouroscopy with the adequate push buttons the half transparency diaphragm to rotate clockwise and counter clockwise.	The fade in flouroscopy picture must be step by step to rotate clockwise and counter clockwise.
19	Arbitrary one, unsecured floppy disk inserts in the floppy disk drive and formatting.	When pushing in the floppy disk in the Floppy disk drive assembly those red lamp briefly shines up. The lamp over the push button "form" shines and the counter display runs against 0.
20	With the hand switch the flouroscopy release.	The radiation indicator shine, the acoustic signal sounded. On the screen the shade picture of the screwdriver is to be seen clear.
21	Push button "disk" press.	Picture 1 is written on the floppy disk. In that right half of the indication area for picture number the number 1 is represented, counted in the left half from 12 to 0.
22	Screwdrivers over approx.. 45° turn (shows now with the point to the screw) and again an automatic flouroscopy releases.	The radiation indicator shine, the acoustic signal sounded. On the screen the shade picture of the screwdriver is to be seen clear.
23	Push button "disk" press.	Picture 2 is written on the floppy disk. In that right half of the indication area for picture number the number 2 is represented, counted in the left half from 12 to 0.
24	The work procedures 22 and 23 is so long too repeat, until six picture are stored.	Fig. 6 is written on the floppy disk. In the right half of the indication area for picture number the number 6 represents, counted in the left half from 12 to 0.
25	Push button "disk" press.	The acoustic signal sounds, on the screen appears the message "DISKETTE VOLL" it means "disk full".

Nr	Activity	Result / Display
26	Picture 1 select and read in.	On the screen the screwdriver is to be seen (picture 1).
27	Push button memory change-over press.	Die bars for memory picture are to be seen.
28	Picture 3 select and read in.	On the screen the screwdriver (picture 3) is to be seen around 90° turned to picture 1.
29	Push button "sub" press.	The lamp over the push button shine. On the screen the picture is represented to by two crossed screwdrivers of one bright, one dark.
30	Push button "sub" press again.	Only picture 3 are represented.
31	Push button "picture rotation in the clockwise direction"(right push button) press to the picture for instance on the head stands.	The picture in the clockwise direction rotates.
32	Push button "picture rotation in the counter clockwise direction"(left push button) press to the picture something to turn back leave.	The picture in the counter clockwise direction rotates.
33	Both push button for picture resetting same time to press.	The picture goes back into the normal position.
34	The picture brightness with the appropriate push button will adjust in such a way that the screen, completely bright or completely dark.	On the screen the changed picture is represented.
35	Both push button for brightness setting at the same time press.	The picture brightness will adjust automatically in according to room lighting. The brightness of the picture is optimally adjusted.
36	The image contrast with the appropriate push button will adjust on the screen in such a way that both possible final values to be reached.	On the screen the changed picture is represented.
37	Both push button for contrast setting at the same time press.	The picture contrast will adjust automatically in according to room lighting. The contrast of the picture is optimally adjusted.
38	With the hand cover the photoelectric cell for the brightness and contrast setting.	The picture becomes somewhat darker and the contrast goes back.
39	X - ray unit and display unit switch off. Disconnect cable connection between electronics block - display unit Connect the display unit directly to the electronics block. X - ray unit switch on.	 After approx.. 20 s a bright circle on the display unit is represented . The lamp over the push button shines and automatic flouroscopy is selected.

Nr	Activity	Result/Display
40	Flouroscopy with the double foot switch / hand switch release.	The radiation indicators shine and the shade picture of the screwdriver are without memory bars on the screen to be seen clear.
41	Push button "R" (left push button) press and thus the mirror representation select.	The picture is represented mirror-image on the display unit.
42	Push button "R" (right push button) press and thus the mirror representation switch off.	The picture is represented normally on the display unit.
43	**REFERENCE** A safe proof of the function is possible only with x - ray films, amplification foil or measuring instruments. - It swings X-ray source out from the image intensifier level - Flouroscopy tubus remove - Collimator installing - C - arm in such a way turn that the X-ray source is directed toward the soil.	
44	Mode of operation “Exposure with fixed data” selects.	The display over the push button shines.
45	Exposure with the hand switch release.	The radiation indicators shine and the acoustic signal sounded.
46	Mode of operation “Exposure with free data” select and set the exposure data at 40 kV, 10 mAs.	The display over the push button shines and the adjusted exposure data’s are displayed.
47	Exposure with the hand switch release.	The radiation indicators shine and the acoustic signal sounded.
48	- Collimator remove - Dentaltubus installing - X-ray source is further against the soil directed.	It is automatically adjusted 60kV.
49	Value for mAs setting to …….. adjust.	New value is displayed.
50	Exposure with the hand switch to release.	The radiation indicators shine and the acoustic signal sounded.

2.5 Burn in the X-ray tube (gettering)

The burn in is to be accomplished:

- With first starting up
- If the x-ray unit 2 years not in operation was

Preparing work

- X - ray unit to flouroscopy adjusted
- Gettertubus installed
- The X – ray tube is toward the soil directed
- The foot switch is connected

ATTENTION The DL times and breaks is absolutely to be kept, it comes otherwise to premature wear or a damage of the x-ray tube!

Nr	Activity	Result/Display
1	X - ray unit and display unit switch on.	The lamps over the push button shines. On the screen the two indications (beam) of "memory picture" must be visible.
2	Push button for permanent “manual flouroscopy” press.	The lamp over the push button shines In the display for flouroscopy data the values are displayed to 40 kV and 0.1 mA.
3	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
4	The KV value around 10 kV increases.	In the display for flouroscopy data the values are displayed to 50 kV and 0,3 mA.
5	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
6	The KV value around 10 kV increases.	In the display for flouroscopy data the values are displayed to 60 kV and 1,5 mA.
7	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
8	The KV value around 10 kV increases.	In the display for flouroscopy data the values are displayed to 70 kV and 2,7 mA.
9	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.

Nr	Activity	Result/Display
10	Make a break for 1 minute.	
11	The KV value around 10 kV increases.	In the display for flouroscopy data the values are displayed to 80 kV and 2.8 mA.
12	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
13	Make a break for 2 minutes.	
14	The KV value around 10 kV increases..	In the display for flouroscopy data the values are displayed to 90 kV and 2.9 mA.
15	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
16	Make a break for 2 minutes.	
17	The KV value around 10 kV increases.	In the display for flouroscopy data the values are displayed to 100 kV and 3,0 mA.
18	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
19	Make a break for 2 minutes.	
20	The KV value around 5 kV increases.	In the display for flouroscopy data the values are displayed to 105 kV and 3,1 mA.
21	Flouroscopy with the double foot switch for 30 sec release.	The radiation indicators shine and the signal sounded.
22	Make a break for 2 minutes.	
23	The KV value set at 60 kV. Flouroscopy with the double foot switch for 90 sec release.	The radiation indicators shine and the signal sounded. After a flouroscopy time of 5 min changes the acoustic signal.
24	Make a break for 10 minutes.	

REFERENCE

If the x-ray unit during the burn in procedure an alarm occurs, the flouroscopy is interrupted and blocked.

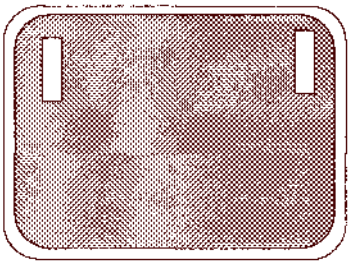
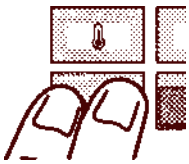
The lamp over the “ON” - switch flashes.

The burn in procedure must be repeated after the elimination of errors.

2.6 System check after short work breaks

REFERENCE This control may be accomplished only by the last operator directly with the X – ray system worked before the work break .

With ambiguity over the condition of the system, the complete system check is to be accomplished.

Activity	Push button	Display
- X - ray unit switch on.		Lamp over the push button shines
- Display unit switch on.		Lamp over the switch shines, for two white bars on the screen from display unit can be seen. 
- Lamp test accomplish		All lamps on the control panel shine and all indicator segments become as "1" or. "8" represented. In the display area for flouroscopy time error 1-9 is displayed.
- Movement of stroke column of the C- arm bracket examine.	 	C-arm bracket lifts itself C-arm bracket lowers itself
REFERENCE If error determined, is to be accomplished the complete system check.		

2.7 Operation of the X – ray unit

With works in sterile areas the sterile cloth covers are needed.

2.7.1 Attachment of the sterile cloth covers

For the cover the following parts are needed:

- 1 x C - arm cover with pushbuttons
- 1 x Cover for image intensifier unit
- 1 x Cover for X-ray source

The covers for image intensifier unit and X-ray source are identical. The covers are washable and sterilizable.

Processing steps in the order:

1. C-arm into a suitable work height drive (approximately on middle height). The image intensifier unit must be above or be placed somewhat diagonally.

ATTENTION The following processing steps must take place via a sterile person!
The covers may be affected only at the exterior!
Only the inside may affect the equipment!

2. Covering the C – arm:
Sterile cover to both sides of the C – arm with the pushbuttons fasten and the strings tie up.

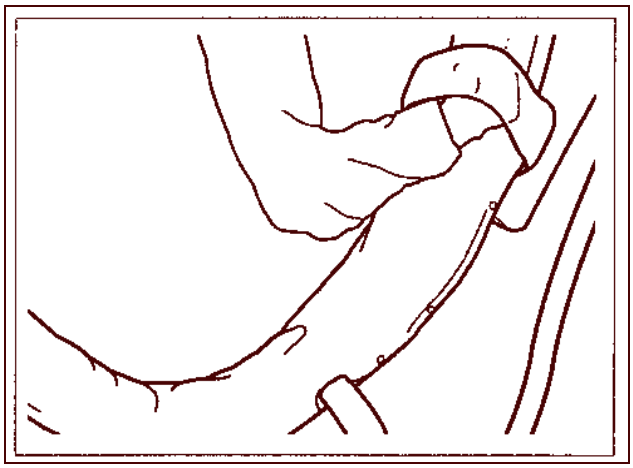


Fig. 148

3. Covering the image intensifier unit.

Cover at the exterior side and from down over the image intensifier unit invert. With the strings the cover is then tightened and fastened to the C-arm side.

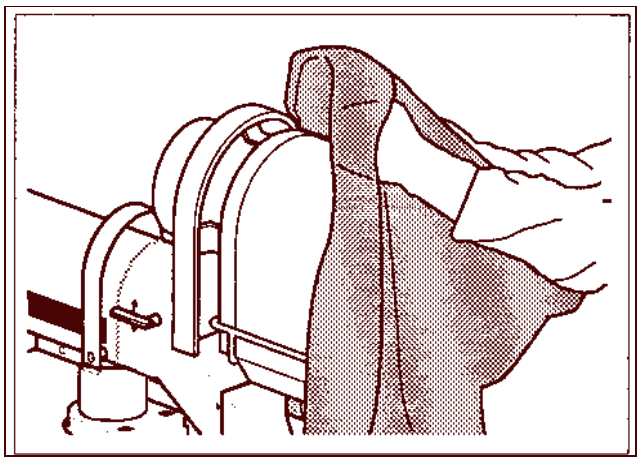


Fig. 149

4. Install the cover for the X-ray source:

Cover at the exterior side and from down over the X-ray source put it on. With the string the cover is then tightened and fastened to the C - arm

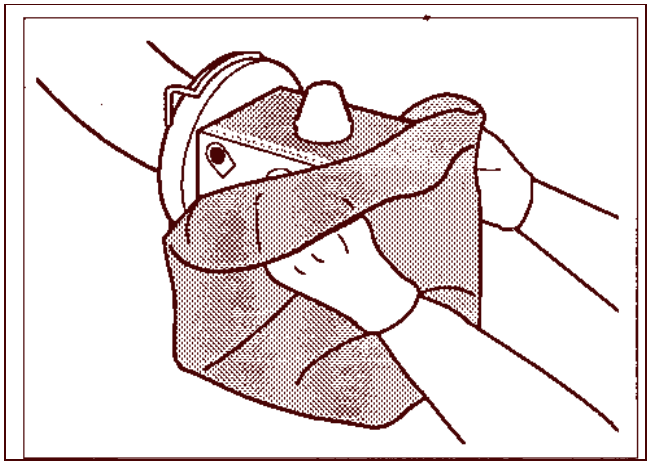


Fig. 150

Fig.151 Shows sterile cloth cover completely attached.

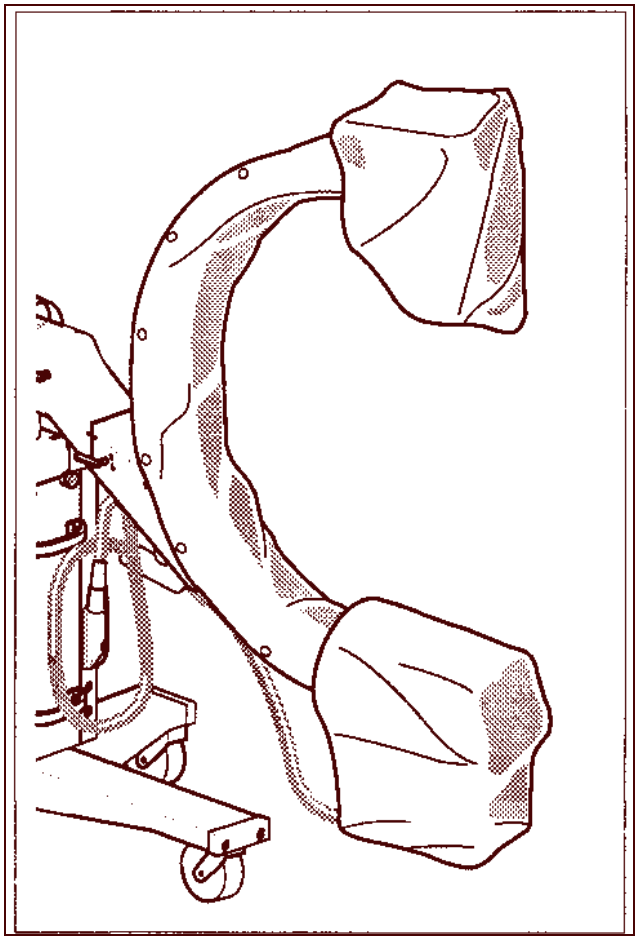


Fig. 151 Sterile cloth cover completely attached

2.7.2 Operation bit map memory unit

2.7.2.1 Handling of floppy disks

The data medium foil in the floppy disk is protected with a plastic housing from mechanical influences. By the shaping of the housing wrong pushing in is impossible into the floppy drive assembly.

The following safety references are to be considered while handling floppy disks.

The side with the inscription sticker is to be turned with inserting into the floppy drive assembly always upward.

The floppy disks may not be put down or stored in direct proximity of magnetized articles (152).

The floppy disks may not be bent.

The sliding metal cover for the cover of the data medium foil may not be moved manually (153).

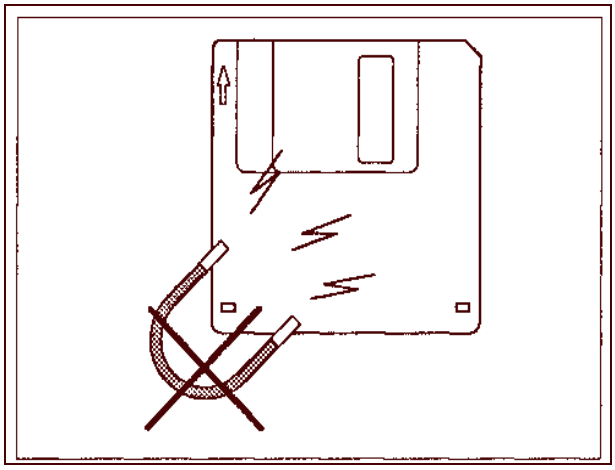


Fig. 152

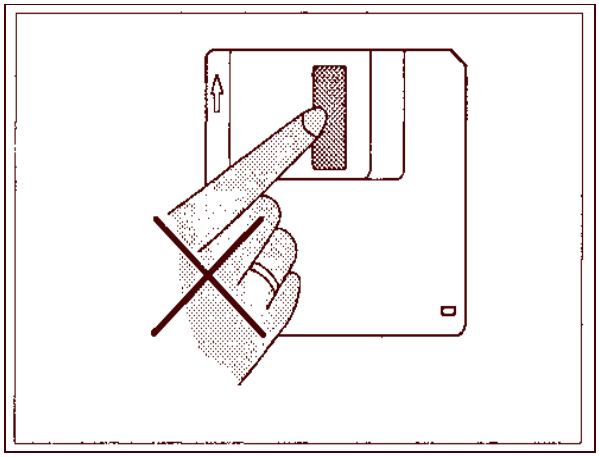


Fig. 153

2.7.2.2 Protection of floppy disks

The floppy disks is provided with a mechanical write protection (154).

Window closed (154/1) Floppy disk can be described.

Window open (154/2) Floppy disk is secured against overwriting.

When using protected floppy disks the following error messages on the display unit are possible:
„DISKETTE FORMATIEREN" means
"DISK FORMATTING" or
„DISKETTE GESICHERT" means
"DISK SECURED".

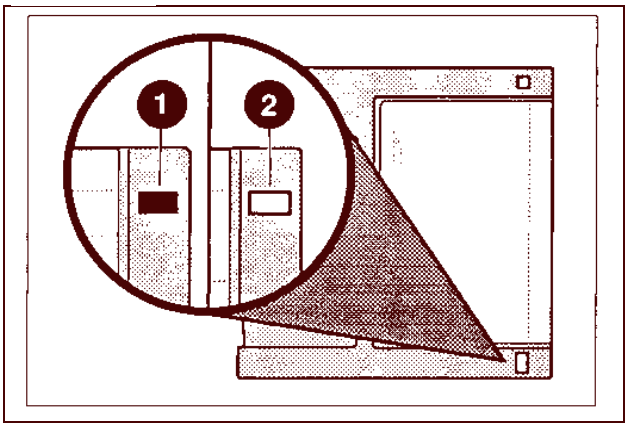


Fig. 154 Floppy diskette write protection

2.7.2.3 Inscription of floppy disks

The floppy disks is to be provided with the following inscription:

Example

- Patient name/first name
- Person index and/or date of birth
- Place of exposure /organisation
- Date/time of exposure

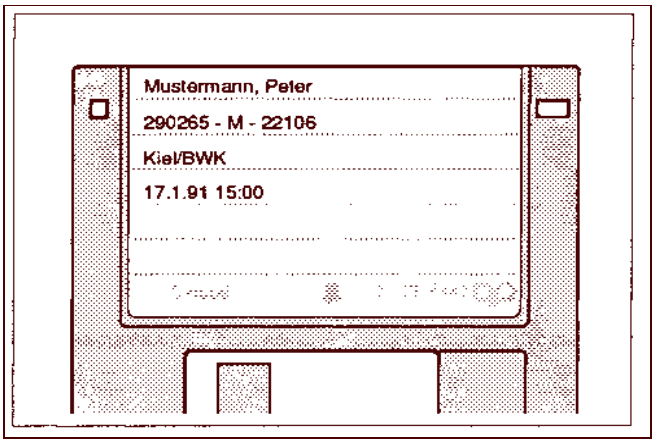


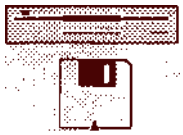
Fig. 155 Floppy disk inscription

2.7.2.4 Formatting floppy disks

New floppy disks must be formatted before use. Floppy disks already used can be deleted by renewed formatting completely.

ATTENTION During formatting possibly existing recordings are deleted!

ATTENTION During the access time (red lamp at the floppy drive assembly) may not be operated the eject button or not be switched off the display unit!

Activity	Push button	Display
1. A not write protected floppy disk into the floppy disk drive push to it engages.		With unformatted disks the audio signal sounds and on the screen appears the message **"DISKETTE FORMATIEREN "**it means **" DISK FORMATTING"**. After approx 20 s. the message to expires
2. Push button "format" press.		Lamp over the tracer flashes and on the screen appears the text **" BESTÄTIGE FORMATIEREN "** it means **" CONFIRMS FORMATTING".**
3. Push button "format" press again.		Lamp over the push button shines, at the same time in the left half of the display area from 79 to 00 is counting.
Take out floppy disk after pressure on the eject button.		

REFERENCE

The following error messages on the screen with this job are possible:

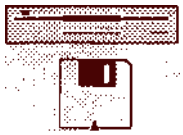
- **DISKETTE GESICHERT** it means
- **DISK SECURED**
- **DISKETTE BESCHÄDIGT** it means
- **DISK DAMAGED**

2.7.2.5 Picture on floppy disk store

The floppy disk with formatting is prepared for storage 6 pictures. When inserting a formatted disk the picture counter stands on 0. The pictures are then written in the order 1.2.3, 4, 5, 6.

The storage of data can take place only with attached X - ray unit.

REFERENCE Being supposed pictures to be stored, then the displayed track must be empty. Existing pictures are otherwise overwritten!

Activity	Push button	Display
1. A formatted, not write protected floppy disk into the floppy disk drive slot push to it engages.		Trace 0 is displayed.
2. If the disk is already described, the number of the last picture is to be selected.		The desired picture number is displayed in the right half of the display area.
3. Push button "store" press.		Lamp over the push button shines and the picture represented on the screen is stored. This procedure is finally appears in the display area the picture number of the stored picture.
4. Take out floppy disk after pressure on the eject button.		

REFERENCE

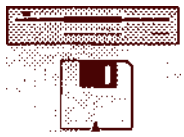
The following error messages on the screen with this job are possible:

DISKETTE VOLL it means
DISK FULL

DISKETTE BESCHÄDIGT it means
DISK DAMAGED

WÄHLE ANDERE SPUR it means
SELECT AN OTHER TRACK

2.7.2.6 Picture from floppy disk reading

Activity	Push button	Display
1. Floppy disk into the floppy disk drive slot push to it engages.		Trace 0 is displayed.
2. The number picture is to be selected.		The desired picture number is displayed in the right half of the display area.
3. Push button "LESEN" (“read”) press.		Lamp over the push button shines and the picture is read in, at the same time in the left half of the display area from 12 to 00 counted. Is this procedure finally appears the selected picture on the screen.
4. Take floppy disk after pressure on the eject button.		

REFERENCE

The following error messages on the screen with this job are possible:

SPUR NICHT LESBAR it means
TRACK DOES NOT READABLY

DISKETTE BESCHÄDIGT it means
DISK DAMAGED

SPUR FEHLERHAFT it means
TRACK FAULTY

BILD FEHLERHAFT it means
PICTURE FAULTY

2.7.3 Flouroscopy

2.7.3.1 Introduction

After switching on the mode of operation flouroscopy with automatic setting is selected All push buttons in the radiography field are blocked with exception of the selection button radiography.

By press of the following push button the different kinds of flouroscopy can be selected:

- Single pulse (snapshot)
- Single pulse (snapshot) with manual setting
- Flouroscopy with automatic dose rate regulation
- Flouroscopy with manual setting
- Pulsed flouroscopy with automatic dose rate regulation
- Pulsed flouroscopy with manual setting

2.7.3.2 Single pulse (snapshot).

REFERENCE The single pulse (snapshot) one implements with a higher mA value.

Preparing work

- Switch the X – ray system on.
- Sterile cloth covers puts on (only with work within a sterile range, see 2.7.1).

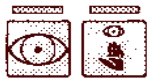
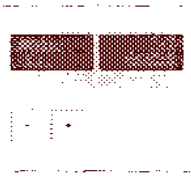
Activity	Push button	Display
1. Push button "flouroscopy" press		Lamp over the push button shines and in the display for flouroscopy data kV and mA-value is represented.
2. Snapshot with the hand switch or double foot switch release.		The radiation indicators shine, the signal sounded and the picture on the display unit are represented. The flouroscopy time is indicated in the flouroscopy time display and should at the end be noted and to the patient data attached.

2.7.3.3 Single pulse (snapshot) with manual setting

REFERENCE The single pulse (snapshot) implements with a higher mA value.

Preparing work

- X – ray system switched on
- Sterile cloth covers puts on (only with work within a sterile range, see 2.7.1)

Activity	Push button	Display
Push button "flouroscopy with manual setting" press		Lamps over the push button shine and in the display for flouroscopy data kV and mA value are displayed.
The KV value individually set. The mA value changes automatically.		In the display area for flouroscopy data the adjusted KV value and the dependent are mA value indicated.
Snapshot with the hand switch or double foot switch release		The radiation indicators shine, signal sounded and the picture in the display unit are represented. The flouroscopy time is indicated in the flouroscopy time display and should at the end be noted and to the patient data attached.

2.7.3.4 Fluoroscopy with automatic setting and pulsed flouroscopy with automatic dose rate regulation.

Preparing work

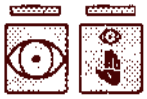
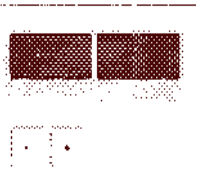
- X – ray system switched on
- Sterile cloth covers on puts on (only with work within a sterile range, see 2.7.1)

Activity	Push button	Display
1. Push buttons "flouroscopy" press or Push buttons "flouroscopy" and push button "pulsed flouroscopy" press.	 	The lamps over the pressed push buttons shines and in the display for flouroscopy data kV and mA value are displayed.
2. Flouroscopy with the hand switch or double foot switch release.		The radiation indicators shines, signal sounded and the picture in the display unit are represented. The flouroscopy time is indicated in the flouroscopy time display and should be at the end noted and to the patient data attached
3. If possibly work with the picture improvement functions.		Picture in accordance with settings

2.7.3.5 Fluoroscopy with manual setting and pulsed fluoroscopy with manual setting

Preparing work

- X – ray system switched on
- Sterile cloth covers puts on (only with work within a sterile range, see 2.7.1)

Activity	Push button	Display
1. Push button "flouroscopy" and pushbutton "manual setting" press. or Push button "flouroscopy" push button "manual setting" and push button "pulsed flouroscopy" press.	 	Lamps over the push button shines and in the display for flouroscopy data kV and mA value are represented.
2. The KV value individually set. That mA value changes itself as well automatically.		In the display area for flouroscopy data the adjusted KV value and the dependent are mA value indicated.
3. Flouroscopy with the hand switch or double foot switch release		The radiation indicators shines, signal sounded and the picture in the display unit are represented. The flouroscopy time is indicated in the flouroscopy time display and should at the end be noted and to the patient data attached.
4. If possibly work with the picture improvement functions.		Picture in accordance with settings

2.7.3.6 Fluoroscopy with subtraction

The subtraction is a special kind of application for the execution of special examination (e.g. contrast medium examine) is suitable, with which the object does not move and changes only the absorption.

Two subtraction procedures accomplished:
- constant subtraction
- additional subtraction

Fluoroscopy with constant subtraction

The first fluoroscopy picture are stored and subtracted in each case when renewed fluoroscopy from the current fluoroscopy picture

Preparing work

- X – ray system switched on
- Sterile cloth covers puts on (only with work within a sterile range, see 2.7.1)

Activity	Push button	Display
1. Screen mask with fluoroscopy or snapshot make.		
2. Push button "memory change" press and thus the picture content in into the background accumulator read in		- Lamp over the push button shines and the picture represented on the display unit is stored.
3. Push button "sub" press.		- Lamp over the push button shines.
4. Second fluoroscopy with the hand switch or double foot switch release and contrast medium inject.		- The radiation indicators shine, the signal sounded. - The current picture is subtracted from the stored picture and the result is represented on the screen.
5. Push button "sub" press again.		- Lamp over the push button expires. The kind of fluoroscopy subtraction is terminated.

Fluoroscopy with additional subtraction

The first fluoroscopy picture is stored and subtracted after renewed fluoroscopy the stored picture from the current picture.

Preparing work:
- X – ray system switched on
- Sterile cloth covers puts on (only with work within a sterile range, see 2.7.1)

Activity	Push button	Display
1. Screen mask with fluoroscopy or snapshot make.		
2. Push button "memory change" press and thus the picture content in into the background accumulator read in.		- Lamp over the push button shines and the picture represented on the display unit is stored.
3. Contrast medium inject.		
4. Second fluoroscopy with the hand switch or double foot switch release.		- The radiation indicators shine, the signal sounded and the picture in the display unit are represented
5. Push buttons "sub" press		- Lamp over the Push button shines - The current picture is subtracted from the stored picture and the result is represented on the screen.
6. Push buttons "sub" press again		- Lamp over the push button expires The kind of fluoroscopy subtraction is terminated.

2.7.4 Radiography

The X - ray unit must be ready for use in the desired kind of radiography. For the setting of the data the right part of the control panel is intended. The left part (fluoroscopy) is blocked after the change-over on exposure.

Exposure can be accomplished with the different exposure dates:

- Exposure with fixed data
- Exposure with free data
- Exposure with hand settings

The structure of the exposure technology is described in the sections 2.7.4.1 to 2.7.4.7.

REFERENCE

With installed fluoroscopy tubus, is automatically selected the kind of radiography
" exposure on cartridges at the image intensifier".
With turned X – ray source this kind of radiography is not possible.

If the collimator is installed, the kinds of radiography " exposure on cartridges on the table or in the wall stand" can be selected.
The kind of radiography " exposure on cartridges at the image intensifier " is blocked.

2.7.4.1 Kinds of radiography

Kind of exposure	Symbols	Preparation
Exposure on cartridges at the image intensifier (only with DL -Tubus)		Cartridge holder install (see 2.7.4.3 cartridge holder installing)
Exposure on cartridges on the Table stand or in the Wall stand		Collimator install (see 2.7.4.6 assembly collimator/tubus) X-ray source to turn (see 2.7.4.7 operation collimator/tubus)
Dental exposure		Dental tubus to install (see 2.7.4.7 operation collimator/tubus)

2.7.4.2 Pre-setting and work routine

Kind of radiography	Positioning	Setting
Exposure on cartridges at the image intensifier	such as fluoroscopy	a) like as fluoroscopy b) 30 cm screen c) 40 cm screen
Vertical exposure	such as collimator install	variable
Horizontal exposure	such as collimator install	variable
Dental exposure		variable

2.7.4.3 Cartridge holder install

Cartridge holder (156/1) take out from the container 2/8 and the spring-actuated lock (157/1) opened.

REFERENCE

With sterile cloth covers put on must be installed the disinfected cartridge holder over the cover.

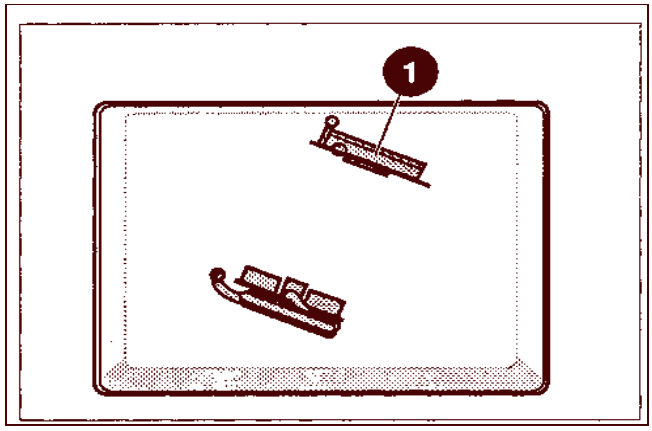


Fig. 156

Cartridge holder from down over the image intensifier unit push and the spring-actuated lock close. The cartridge holder can be turned around 360° into each desired position.

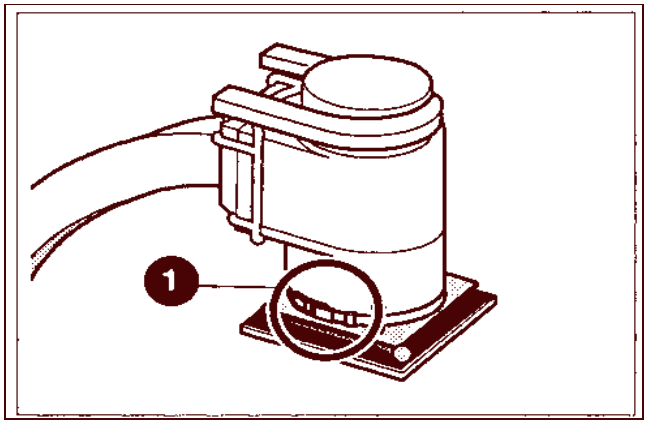


Fig. 157

The spring-actuated lock is provided with an adjusting screw. When using the sterile cloth covers the closing range thereby can be placed. Proceed as follows in addition: Sterile cloth cover put on.
The adjusting screw (158/1) some revolutions loosen. Cartridge holder put on (hold!) and spring-actuated lock close.
Now tighten the adjusting screw.
The cartridge holder must be connected with the image intensifier unit anti-swivelling

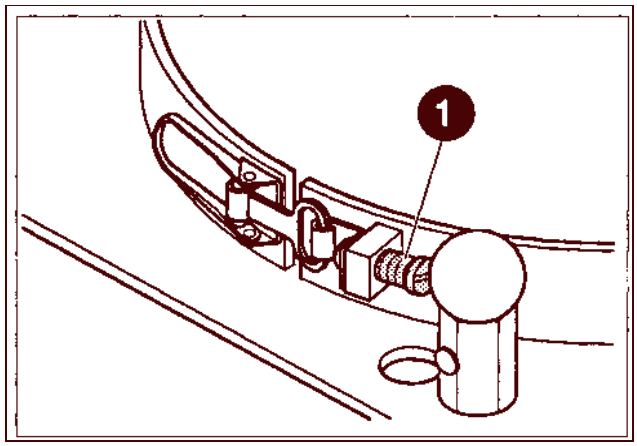


Fig. 158

2.7.4.4 Operation of the cartridge holder

1. Knob (159/3) to keeping the cartridge holder open for the fluoroscopy operation with installed cartridge holder.

2. Lever (159/2) to the opening of the cartridge holder for pushing and centering the cartridge in.

3. Centering knob (159/1) to centering the 18 cm cartridges. For longer cartridges the knob must be pulled out.

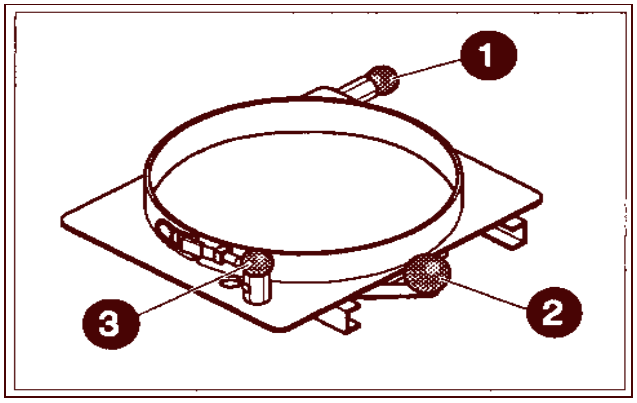


Fig. 159

2.7.4.5 Rotation of the X-ray source

The X-ray source can after pulling out the button (160/1) be rotated gradually around +/-100°. If the button is released, it engages again and holds the X-ray source in the new position.

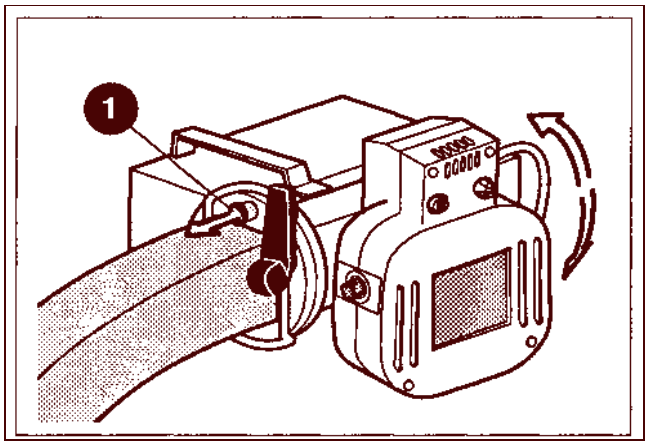


Fig. 160

2.7.4.6 Collimator/tubus installation

ATTENTION

After the mounting of the collimator the C - arm is no longer weight balanced!

With the replacement of the different tubes or the collimator at the X-ray purity or at the left side of the electronics block is to be proceeded in accordance with the following

Removing

1. Latch plate (161/1) to the side push.
2. Plug connector (only collimator) from the blind plug socket loosen
3. Tubus or collimator (161/2) remove.

Installing

1. Tubus or collimator when assembling plate diagonally puts. The red points must face each other (161/3).
2. Tubus or collimator to press downward and engage leaves
3. Put the plug when the assembling of the collimator into the plug socket at the side of the emitter and/or into the blind plug socket or the transport lock.

In the fig. 162 the installed collimator is represented

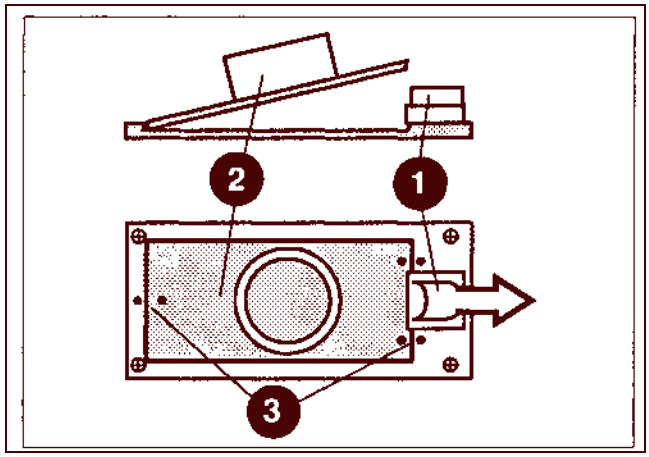


Fig. 161

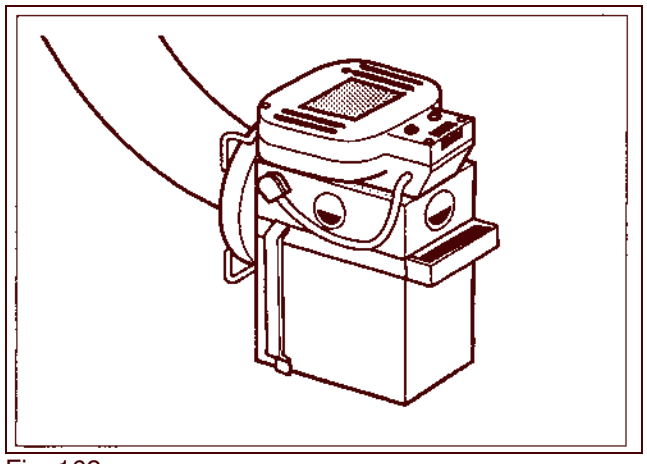


Fig. 162

2.7.4.7 Operation collimator Light button

The light shines after the pressing the light button (164/1) approx.. 30 s. The light field is identical to the radiation area.

Tape measure

The tape measure (164/2) used for the determination of the focus film distance (FFA). Take the tape measure carefully out for measuring.
For rolling up the tape measure keep it easy and loosen the clamp.

Insertion

With the adjusting knobs (164/3,164/4) can be faded in the radiation field.

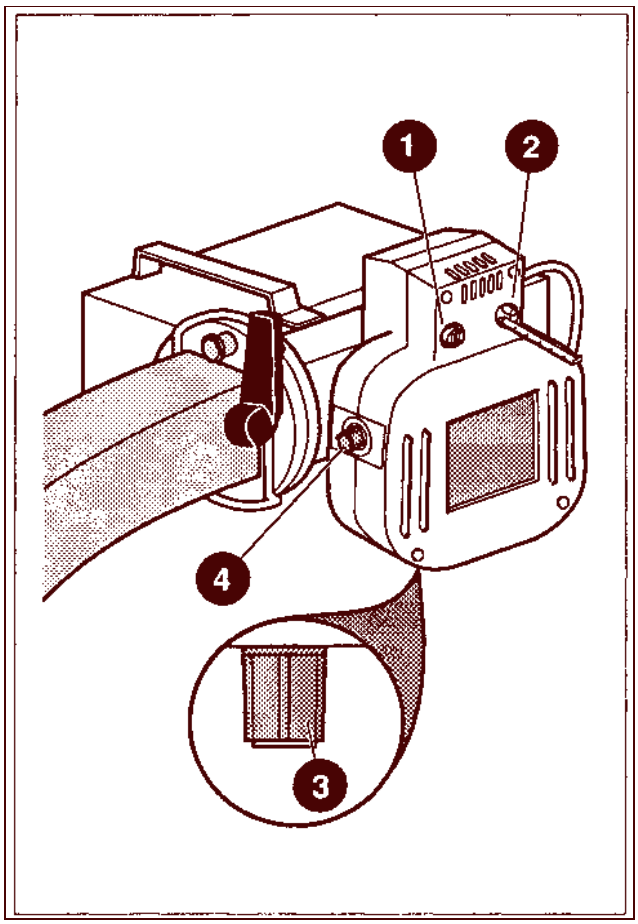


Fig. 163

2.7.4.8 Exposure with fixed parameter

REFERENCE

After switching on the X – ray equipment is automatically preseted to "fixed data".

Activity	Push button	Display
1. If the signature "FEST" does not shine, push button fixed-free data touching short.		Shines the signature "FEST".
2. With the selector buttons "radiography operation" the desired kind select. Exposure on cartridge holder at the image intensifier Exposure on table Exposure on cartridge stand	 	The lamp over the selected push button shines.
3. Patient range select Both for frontal and for lateral exposure the patient range can be with the push buttons upward or downward select. Over for the same patient range of the frontal into the lateral level, or in reverse, to arrive short touching of push button lightly Example: Head a.p. is selected, a push button under the lateral range short touching and heads laterally is selected.		The selected range shines

Activity	Push button	Display
4. Patient-thickness-adapt With one the push button thinly normally or thickly Make an selection. **CAUTION** Before exposure release the exposure data with the experience data compare.	 	- The values are taken over from the program table, adapted to the object thickness. - The exposure data are indicated in the display areas for "**kV**" and "**mAs**".
5. The exposure with the hand switch release. **CAUTION** The X - ray unit works with a pre delay time of 0,8 s.		- The radiation indicators shine (with not attached display unit only at the electronics block), the signal sounded.
6. Cartridge take out. The X -ray unit is again ready for a new exposure.		

2.7.4.9 Exposition Table

REFERENCE The table to universal foils and average patients.

Application / Range	Cartridge at the image intensifier kV	mAs	R	Table kV	mAs	R	Wall stand kV	mAs	R
Head, ap/pa	78	20		88	24	+	88	24	+
Head, laterally	68	20		78	24	+	78	24	+
HWS	65	12		65	32	+	65	32	+
Shoulder	50	24		60	40	+	60	40	+
Lung, pa							105	4,8	+
Lung, laterally							105	8,2	+
BWS, ap	65	12		65	32	+	65	32	+
BWS, laterally	75	20		85	24	+	85	24	+
Breastbone, pa	70	4		72	8	+	72	8	+
Breastbone, laterally	85	16		88	32	+	88	32	+
LWS, pa	70	20		80	32		80	32	+
LWS, laterally	95	16		100	32		100	32	+
Pelvis, ap	75	12		88	24	+	80	24	+
Thigh, ap	62	20		65	40	+			
Thigh, laterally	55	20		60	40	+			
Knee, ap	55	12		55	16				
Knee, laterally	50	12		55	16				
Lower lag	50	8		50	10				
Foot joint	50	10		50	12				
Foot	45	8		45	10				
Elbow	45	16		45	20				
Lower arm	45	16		45	20				
Wrist, ap	50	8		50	10				
Wrist, laterally	45	10		45	12				
Hand	45	8		45	10				

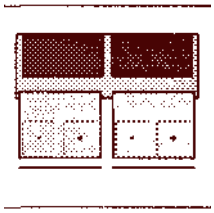
High-sensivity foil (DIN 200): mAs-value divide in halve
Fine drawing foils (DIN 50): mAs value make it double

Very strong patient: kV + 10%
Very slim patient: mAs value divide in halve

2.7.4.10 Exposure with variable parameter (free data)

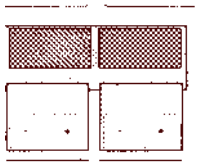
REFERENCE This kind of radiography must be specially selected.

Activity	Push button	Display
1. If the signature "FEST" does not shine, push button fixed-free data touching short.		- Shines the signature "FREI".
2. Possibly make amplifier foil correction.		- The adjusted value shines. **REFERENCE** The value should be set after the exposure manually again to 1.
3. .With the selector buttons "radiography operation" the desired kind select. Exposure on cartridge holder at the image intensifier Exposure on table Exposure on cartridge stand		- The lamp over the selected push button shines.
4. Patient range select Both for frontal and for lateral exposure the patient range with the push buttons upward or downward can be select. Over for the same patient range of the frontal into the lateral level, or in reverse, to arrive short touching of push button lightly. Example: Head a.p. is selected, a push button under the lateral range short touching and heads laterally is selected.		- The selected range shines.

Activity	Push button	Display
5. Patient-thickness-adapt With one the push button thinly normally or thickly Make an selection.	 	- The values are taken over from the program table, adapted to the object thickness. - The exposure data are indicated in the display areas for "**kV**" and "**mAs**".
6. The values for kV and mAs set.		- The values are indicated in the display.
CAUTION Before exposure release the exposure data with the experience data compare. 7. The exposure with the hand switch release. **CAUTION** The X - ray unit works with a pre delay time of 0,8 s.-		- The radiation indicators shine (with not attached display unit only at the electronics block), the signal sounded.
8. Cartridge take out. The X -ray unit is again ready for a new exposure.		

2.7.4.11 Radiography with manual setting

REFERENCE This kind of radiography must be specially selected.

Activity	Push button	Display
1. Selection button "kind of radiography hand exposure " press.		- The lamps over the selected push buttons shine
2. The values for kV and mAs set. **CAUTION** Before exposure release the exposure data with the experience data compare.		- The values are indicated in the display.
3. Exposure with the hand switch release. **CAUTION** The X - ray unit works with a pre delay time of 0,8 s.		- The radiation indicators shine (with not attached display unit only at the electronics block), the signal sounded.
4. Take the hand setting back by pressures of the push button "kind of radiography automatic exposure" or by renewed pressing of the push button "hand exposure".		- The lamp over the push button " automatic" shines.
5. Cartridge take out. The X -ray unit is again ready for a new exposure.		

2.7.4.12 Adjusting examples of radiography operation at outside of the C- arm

Examples of the different settings of the x-ray unit at the table (run raster drawer) and for exposures on the cartridge stand at the table.
Three different height ranges can be selected by turn of the C - arm, an accurate setting effected via the motor vertical adjustment of the stroke column.

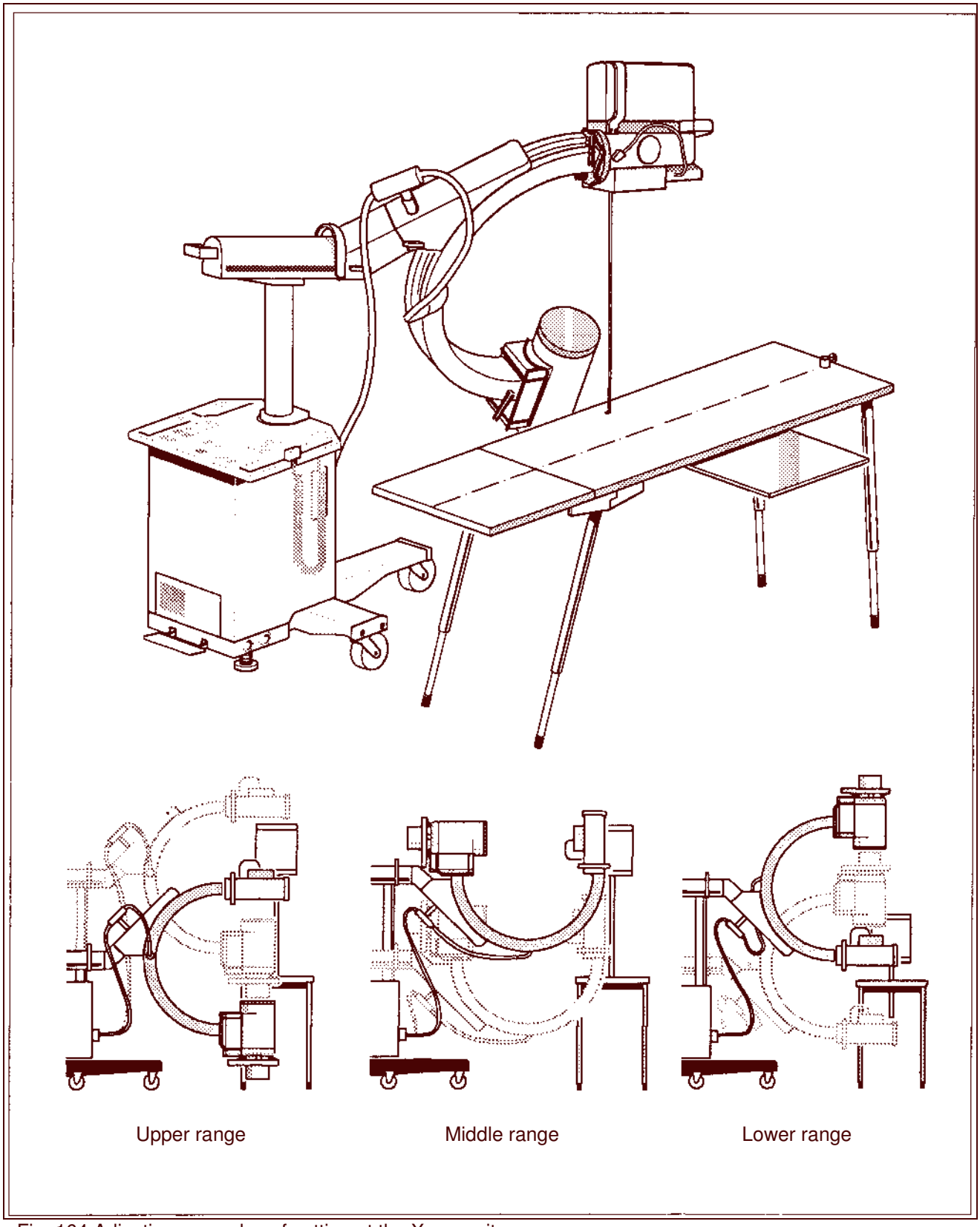


Fig. 164 Adjusting examples of setting at the X-ray unit.

2.7.4.13 Adjusting examples of dental exposure.

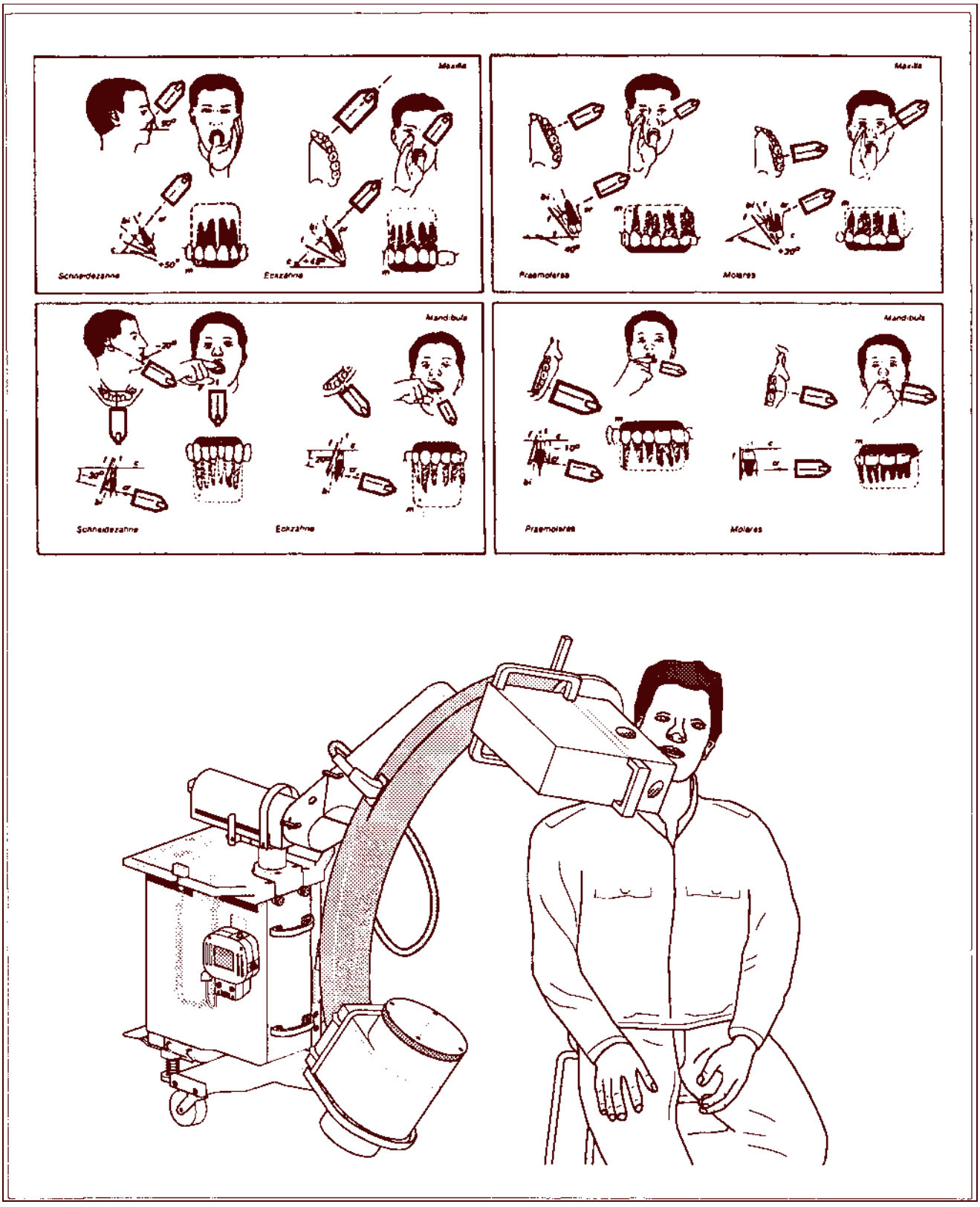


Fig. 165 Examples of the different settings of the x-ray unit for dental exposure

2.7.4.14 Radiography mode dental

Preparing work

- Make patient positioning

Activity	Push button	Display
1. Take out the dental tubus from container 4/8 and install.		- In the display area "kV setting" is indicated the value 60 kV. The value is given by the program.
2. The value for mAs freely set.		- In the display the adjusted value is represented.
3. X – ray source with dental tubus to that tooth which can be exposed adjust.		
4. Positioning the tooth film.		
5. The exposure with the hand switch release. **CAUTION** The x-ray unit works with a pre delay time of 0,8 s.		- The radiation indicator shines (with not attached display unit only at the electronics block), the signal sounded.

Exposure table for BV25T with dental tubus (20.5 cm FHA)

Range 60 kV/20 mA	Sensivity * 1	Sensivity * 2	Sensivity * 3	Sensivity * 4
Incisors	0,040	0,063	0,100	0,160
Canine tooth	0,040	0,063	0,100	0,160
Premolar teeth	0,050	0,080	0,125	0,200
Lower molar tooth	0,063	0,100	0,160	0,250
Upper molar tooth	0,080	0,125	0,200	0,320
Bite wings	0,063	0,100	0,160	0,250
Occlusal overlay	0,100	0,160	0,250	0,400

REFERENCE Exposure times in seconds!

Correspond to the sensitivity classes:

1. Digital radiography systems (VISUALIX)
2. Tooth film AGFA Dentus M4
3. Tooth film KODAK Ektaspeed (E-type)
4. Tooth film KODAK Ultra speed (D-type)

2.8 Putting out of operation

The X-ray unit as follows out of operation set:
- Display unit switch off.
- X - ray unit switch off.
- Mains connection cables disconnect from mains.
- Remove floppy disk from the floppy disk drive assembly and reliably store.
- Sterile cloth cover of the x-ray unit remove.
- X - ray system clean and disinfect.

2.9 Disassembling to the transportation/dispatch

2.9.1 Preparations to the dismantling

1. Container 1/8 - 8/8 according to the space conditions outside of the disassembly place put down and open it.
2. The mounting plates in the containers loosen and open it or take out.
3. Before the dismantling the x-ray system, is to set in accordance with 2.8 except operation.
4. For the dismantling of the x-ray system, two men (one with training) are needed..

2.9.2 Dismantling and packing of the X - ray unit and the display unit.

- The dismantling of the X - ray unit and the display unit takes place in reverse order like the structure (section 2.1.3 and 2.1.4).
- All parts are correctly to be fastened in the mounting plates of the individual crate employments.
- Broken out guidance woods from the transportation crates are to be left in the appropriate crate.

- Foot brake determine

- Connect to the mains, X ray unit switched on and the stroke column drive into the packing position

- In addition the button laterally on the stroke column present is "packing" (166/1) and one the "C – arm lower" push button (166/2) to press, until the stroke column achieved its deepest position

- Subsequently, X ray unit switch off and disconnect from mains

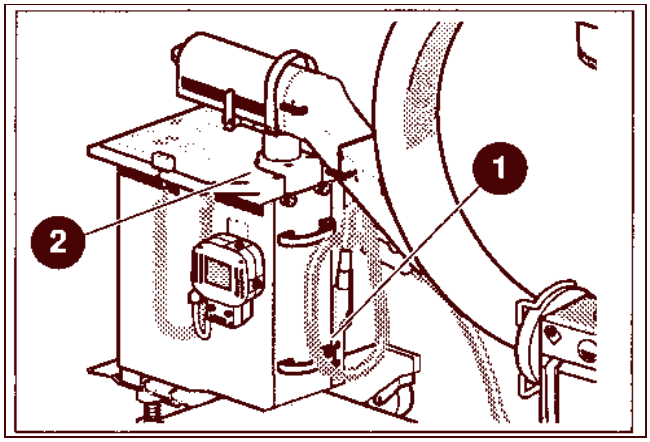


Fig. 166

2.9.2.1 Container 8/8

1. Cable connections X - ray unit/display unit, potential equalization lines disconnect and winding on the cable carrier.
2. Radiation indicators of the display unit remove and store it in the drawer (bit map memory unit).
3. Cable from the plug socket "monitor" at the bit map memory unit loosen and into the mounting plate at the display unit hang up.
4. The four fixing bolts of the display unit loosen, remove the display unit from bit map memory unit and put in with the back to the cover into the container 8/8, the mounting plates towards near-fold and with the spring-actuated locks secure.
5. Cable carrier into the container 8/8 insert and lock.
6. Control the contents of the containers 8/8 according to loading plan, check the fixed seat of all parts and close the container.

2.9.2.2 Containers 7/8

1. Control the contents of the drawer in accordance with loading plan. Existing gettertubus take out and in the container 4/8 stow away.

2. The four fixing bolts at the lower surface of the support plate loosen, remove the bit map memory unit and put in the container 7/8.

3. Mounting plates with the padded side inward set and close.

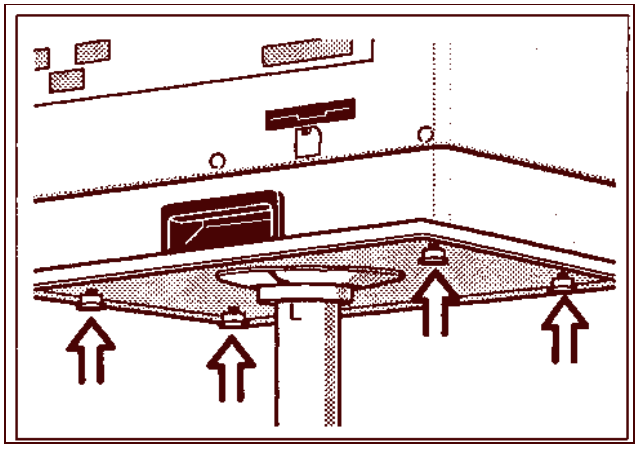


Fig. 167

4. Control the contents of the container 7/8 in according to loading plan, check the fixed seat of all parts and close the container.

2.9.2.3 Containers 6/8

1. The hand wheel on the support plate of the trolley loosen, the support plate remove and insert into the transportation crate.

2. Hand wheel down loosen, the desk top carrier remove and insert into the container 6/8.

3. Wheels of the chassis inward place, the brakes determine and the basic frame insert into the container 6/8.

4. Contents of the container 6/8 according to loading plan control, mounting plates put on and lock, close the container.

2.9.2.4 Containers 5/8

REFERENCE

The X-ray source is to be always first removed. The C - arm is otherwise no longer weight balanced and could tilt.

1. Place C - arm in a horizontal position.

2. Install the fluoroscopy tubus at X-ray source unit.

3. The locking knob in the locking handle of the X-ray source pull out and in such a way rotate that it remains in this pulled out position.

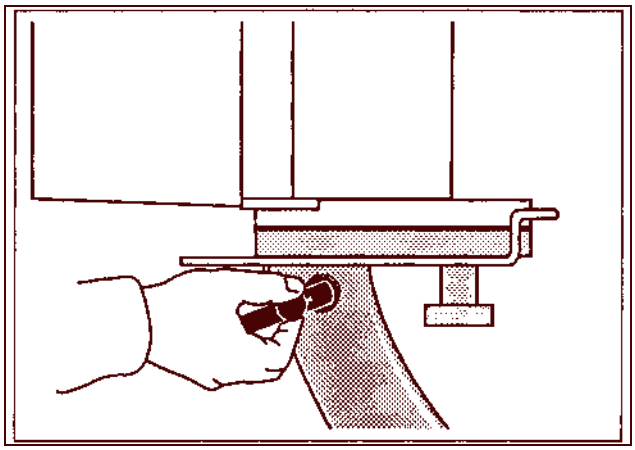


Fig. 168

X-ray source hold on and the locking handle turn in the counter clockwise direction up to the fixing point.

ATTENTION

The locking knob in the locking handle turn back again!

4. X-ray source take off and insert into the containers 5/8.

5. Close the mounting plates.

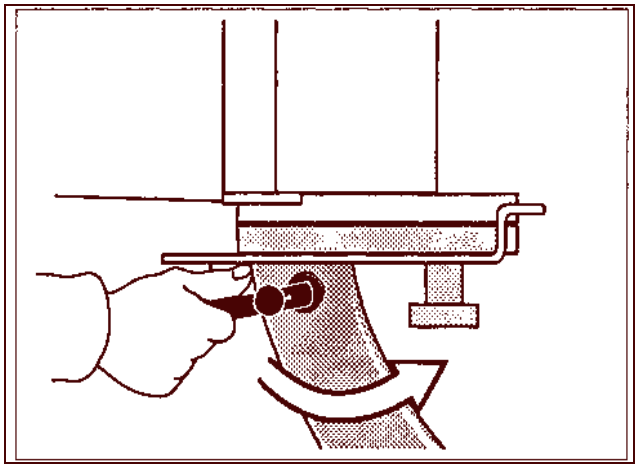


Fig. 169

6. The locking knob in the locking handle of the image intensifier unit pull up and in such a way rotate that it remains in this pulled out position.

7. Image intensifier unit hold and the locking handle turn in the counter clockwise direction up to at impact.

ATTENTION

The locking knob in the locking handle turn back again!

8. Image intensifier unit take off and inserted into the container 5/8, mounting plates close and lock.

9. Both arranging baskets from the C - arm to loosening of the screws remove and put it in the container 5/8.

10. Control the contents of the containers 5/8 in according to loading plan, check the fixed seat of all parts and close the container.

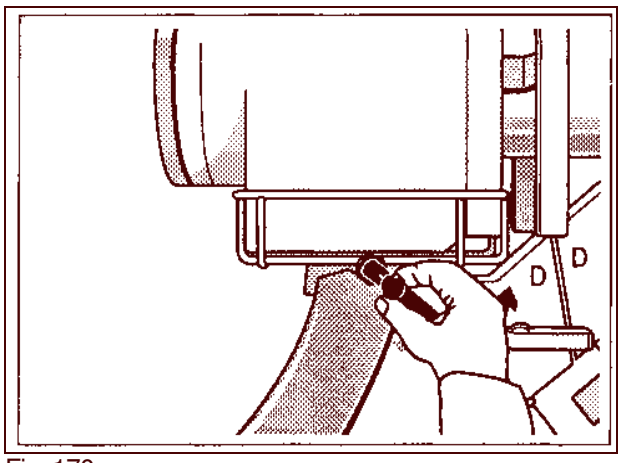


Fig. 170

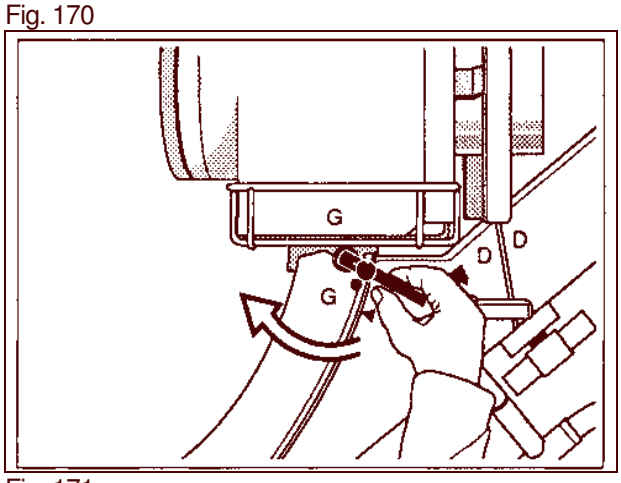


Fig. 171

2.9.2.5 Container 4/8

1. The collimator remove and put into the container 4/8 . Connecting cable put into the fixing clamp, close and lock the mounting plate.

2. Dental and gettertubus put it back to the container 4/8.

3. Cable supports for the cable connection loosen from the C - arm.

4. C - arm turn to the disassemble position. The red marking (172/1) at the C - arm to the marking (172/2) align and the brake tighten.

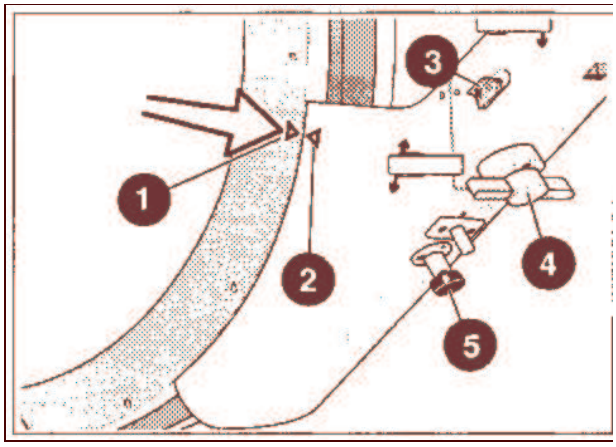


Fig. 172

5. The transport lock (172/5) turn, until it engages audibly

6. Take out the connector of the connection cable after release the safety screw from the electronics block.

7. Loosen the locking grip (172/4) at the C – arm.

8. Shift the safeguard barrier (172/3) in the direction of the arrow, which cable connections hang over the shoulder and take the C - arm off upwards, inserted it into the container 4/8 and the connection cable attach to the cable support. Subsequently, close and lock the mounting plates.

9. The brake lever for fan movement (173/2) put up, the brake lever for forward-backward movement (173/1) loosen and the C-arm bracket drive into the packing position. The red markings at the side of the housing must be stay one upon the other. Tighten afterwards the brake lever for forward-backwards movement again.

10. The C-arm bracket remove upward and insert into the container 4/8.

11. Brake levers for fan movement again press into the horizontal position. Subsequently, close and lock the mounting plates.

12. Contents of the containers in according to loading plan control, check the fixed seat of all parts and close the container.

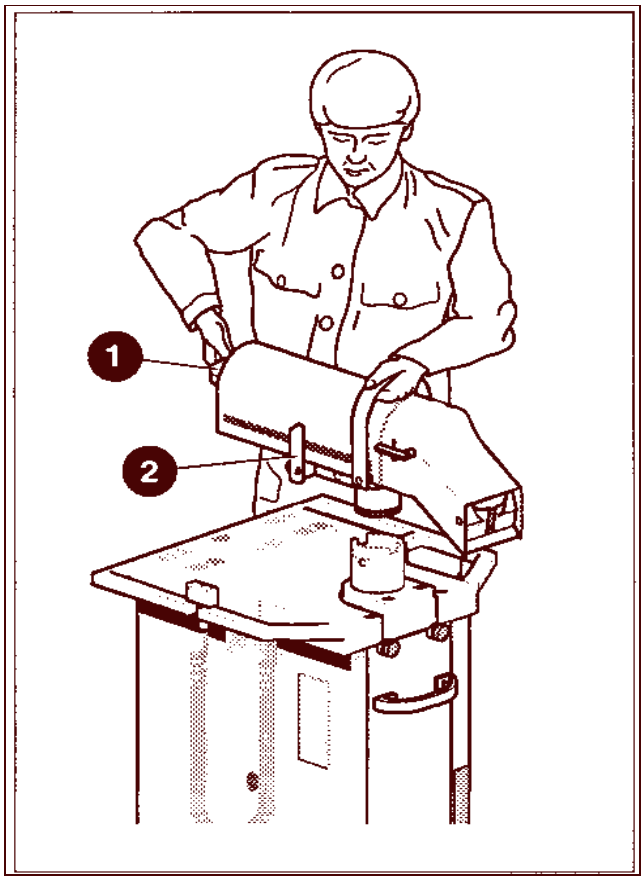


Fig. 173

2.9.2.6 Container 3/8

1. Loosen the connector , remove the double foot switches and placing in the container 2/8.

2. Mains connection line roll up and fasten it.

3. Both locking knobs (174/1) of the electronics block pull out and tighten.

4. The electronics block raise carefully, move to the rear and take it off.

5. The electronics block move carefully to the transport supporting fixture of the container 3/8 hang up on the base plate, touch down and secure it with locking (175/1)mechanism.

6. Check the fixed seat of all parts and close the container 3/8.

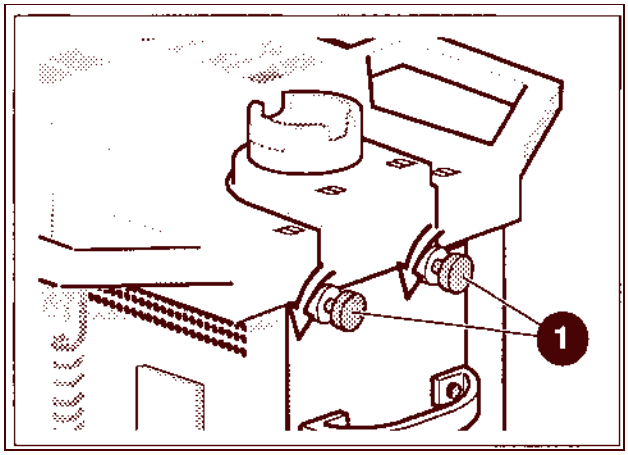


Fig. 174

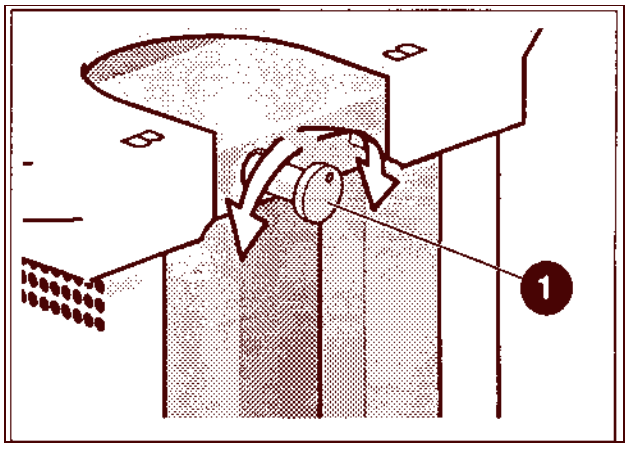


Fig. 175

2.9.2.7 Container 2/8

1. The cartridge holder put it into the container 2/8

2. Examine whether the stroke column was driven into the packing position. If in the case of a power failure the stroke column did not be driven down by Motor could, then this can be turned with the crank handle into the deepest position.

3. At the chassis both placed locking latch plates (177/1) loosen. In addition only from the side, as reach shown in fig. 178 into the locking recesses, so that the fingers cannot turn out under clothe sheet metal.

4. The stroke column easily tilt, from the chassis take off and inserted into the container 2/8. Subsequently, close and lock the mounting plates.

5. Contents of the containers in according to loading plan control, check the fixed seat of all parts and close the container.

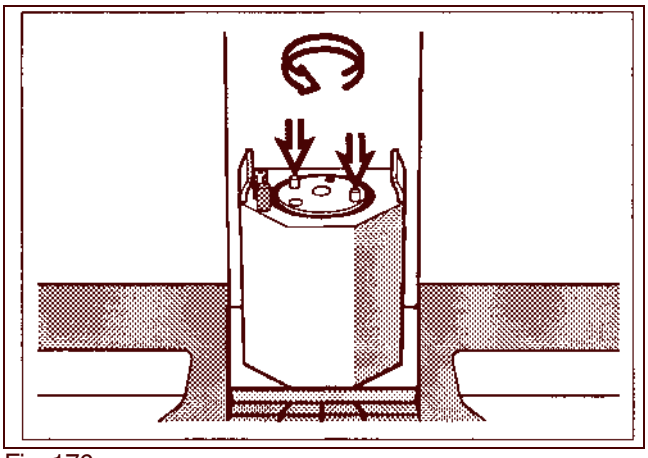


Fig. 176

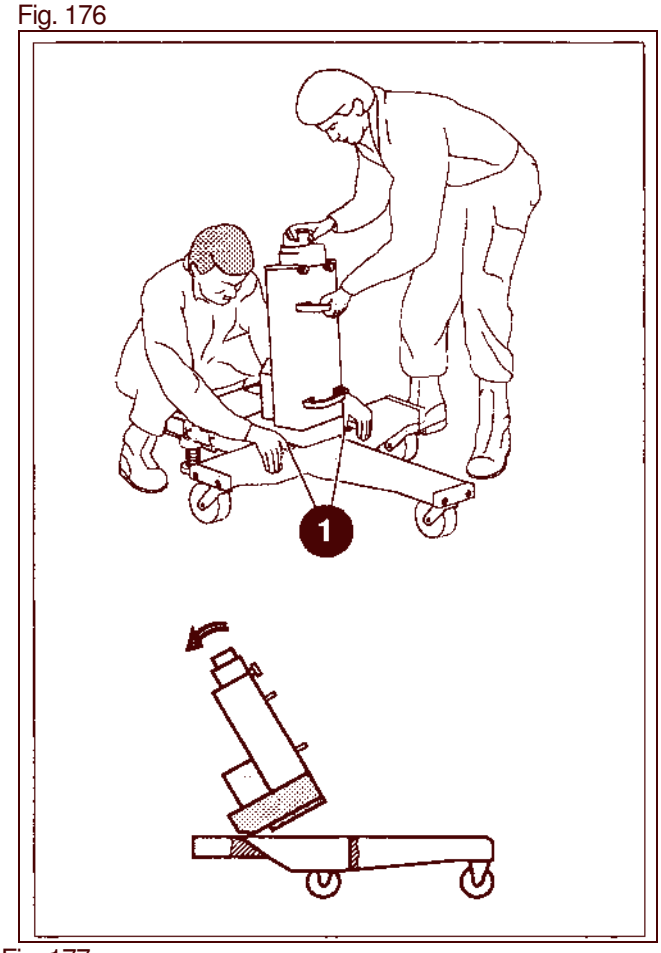


Fig. 177

2.9.2.8 Containers 1/8

1. Insert the documentation into the container 1/8.

2. Foot brake of the chassis loosen, the chassis take up and put it to the container 1/8. Subsequently, close and lock the mounting plates.

3. Contents containers of the 1/8 according to loading plan control, check the fixed seat of all parts and close the container.

2.10 Operation and working under special climatic or other conditions.

The X-ray system ensure a trouble free operation in the temperature range of 0 °C to +35 °C.

REFERENCE

With the employment of the x-ray system at temperatures over 35°C while away the on time up to switching off the X – ray source.

2.11 Operation with a generator aggregate

The connection of the x-ray system to the generator aggregate must be take only with the specifying components

Designation	Type	Remarks
Mains cable	H07RN-F5G4.	max 2 pieces
Power cable	DS 32A 22/380V	max. 2 pieces

The potential equalization lines must be attached.

2.12 Servicing, maintenance, period work, trouble shooting and repair

2.12.1 Introduction

For the preservation of the readiness of application of the equipment is necessary regular maintaining and maintenance work as well as technical examinations as period work.

They are to be accomplished by the user/operator or by medical equipment technician.

The period work is partitioned as follows:

- Period work on the "coming into use"
- Period work on the "stored equipment"

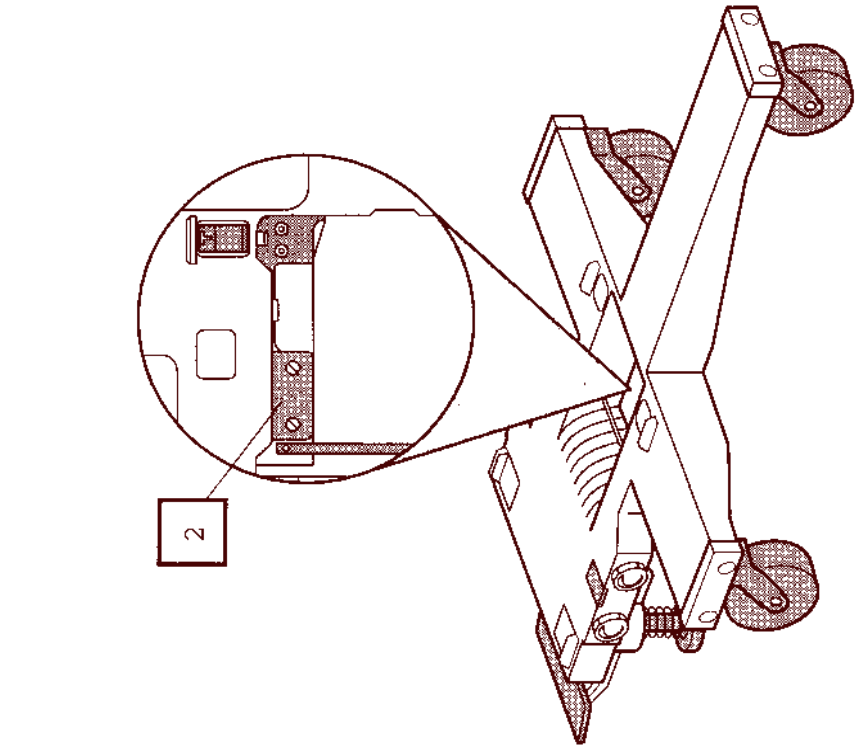
The period work refers in principle to the completely assembled equipment.
The accomplished period work is to be registered equipment handbook medical equipment .

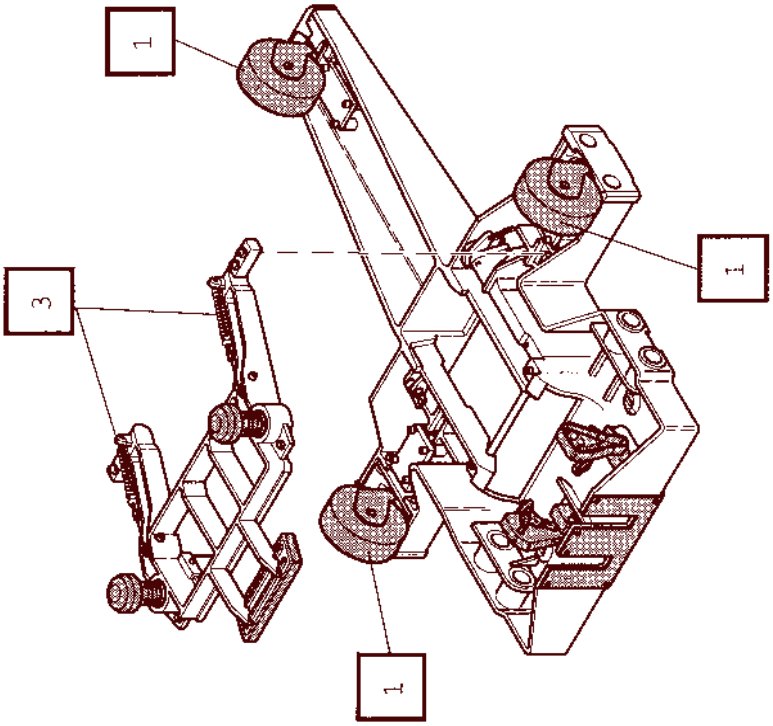
Assignment	Realisation
Technical check up Maintenance Function checks Easy troubleshooting and repair	User/operator Especially trained personal
Easy repairs on the mechanical and Electrical assemblies and subassemblies Periodic part changes Easy modification	Especially trained personal
Repairing difficult faults Difficult modification Change from assemblies Repair from assemblies	Electronic technician

2.12.2 Time table for periodic work

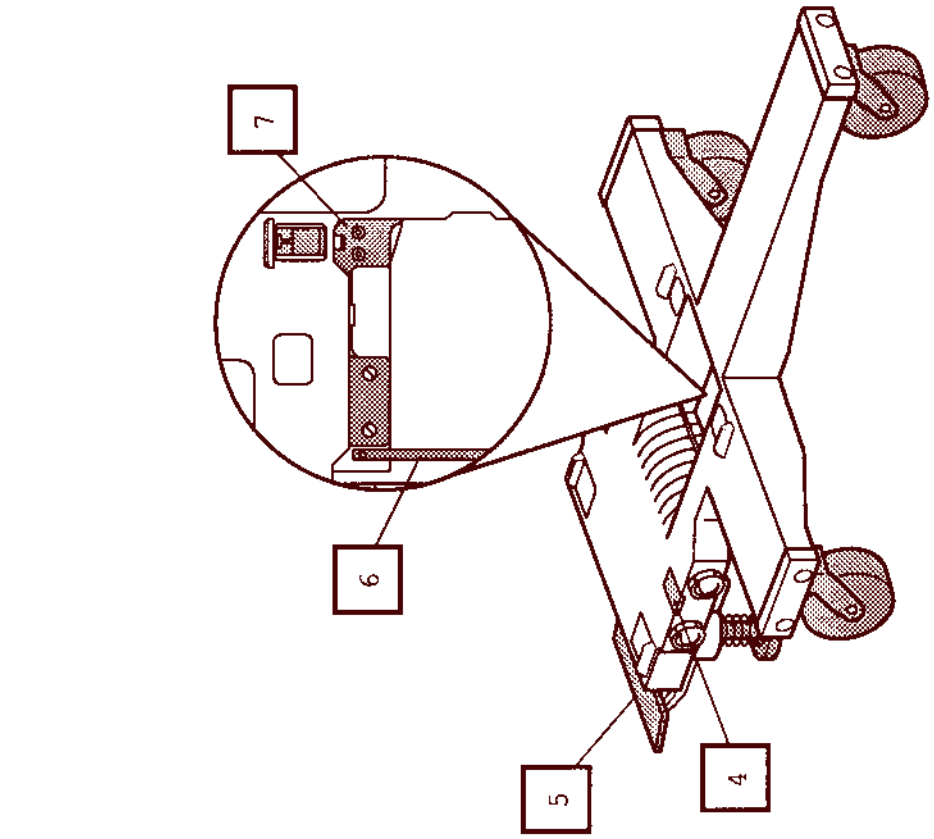
2.12.2.1 Period work on the "X – ray equipment into use"

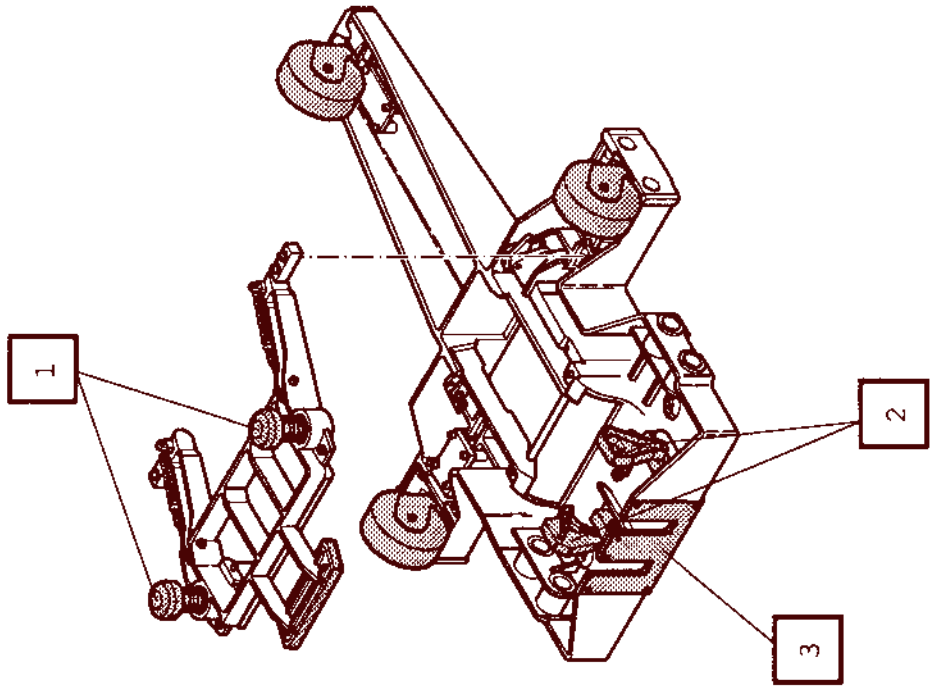
Nr.	Check point/ description	Symbol or place nr.	Test / Activity	Rated value/ lubrication	Page (reference)	Timetable
1	2	3	4	5	6	7
1	**X-ray system**		- Check inscriptions and warnings for perfect legibility. - Check cables and connections for perfect condition. - Constant examination in accordance with chapter 2.17 accomplish. - Function checks without and with generating radiation in accordance with 2.4 accomplish. - Burn in procedure in accordance with 2.5 accomplish.		174 71 85	Monthly Monthly Monthly Annually as required e.g. after HV sparks or X – ray tube exchange;
2 2.1	**Chassis X - ray unit** Wheels		The chassis with the wheels ABOVE and those put on the soil check the function of the wheels.			Annually
2.2	Wire rope with spring		Check for perfect attachment and for damage.			Annually
2.3	Guide plate		The chassis with the wheels place in direction DOWN on the soil and check the guide plate for perfect attachment and for damage			Annually


2

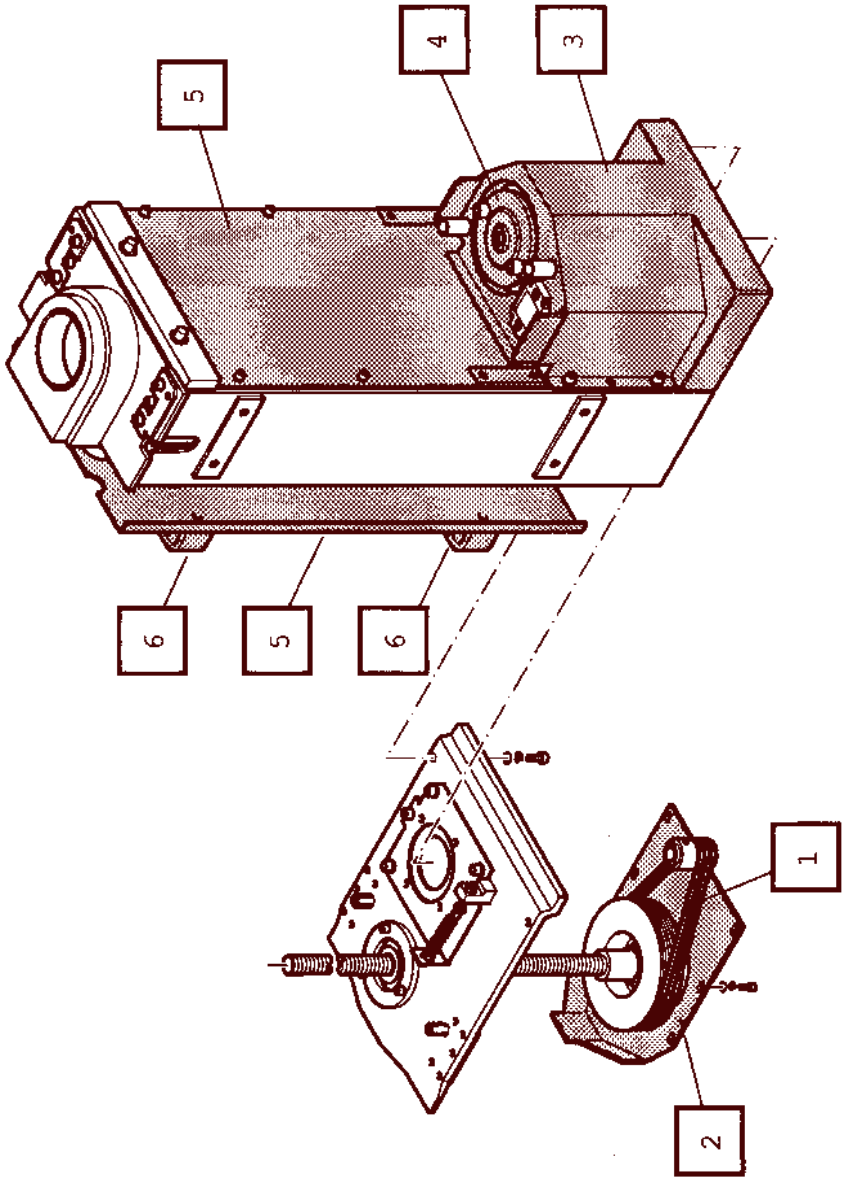

1
3
1
1

Nr.	Inspection station Designation	Symbol/ position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
2.4	Groove plate	4	For perfect attachment and for damage check.			Annually
2.5	Guidance wave for stroke column	6	For bending back the guidance wave check.			Annually
2.6	Kick strip plate	3	For perfect attachment and for damages check.			Annually
2.7	Rubber of the brake pedal	5	For perfect attachment and for damages check.			Annually
2.8	Brake shoe	1	The brake shoes check, it must be fixed sit and not be allowed to damaged.			Annually
2.9	Locking handle for stroke column	7	Stroke column install and the perfect mounting plate and safety device of the locking handles check.			Annually

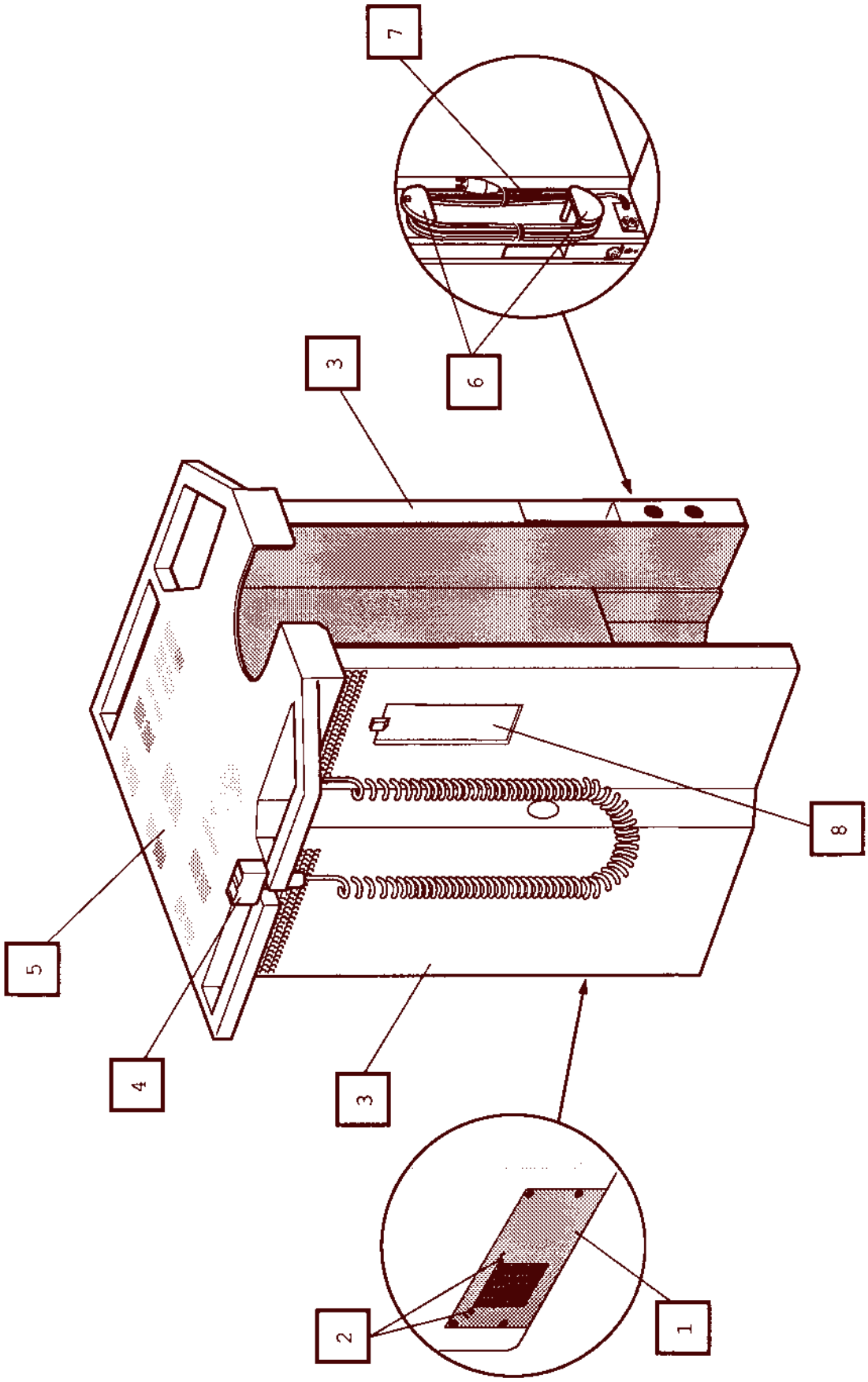

7
6
5
4


1
2
3

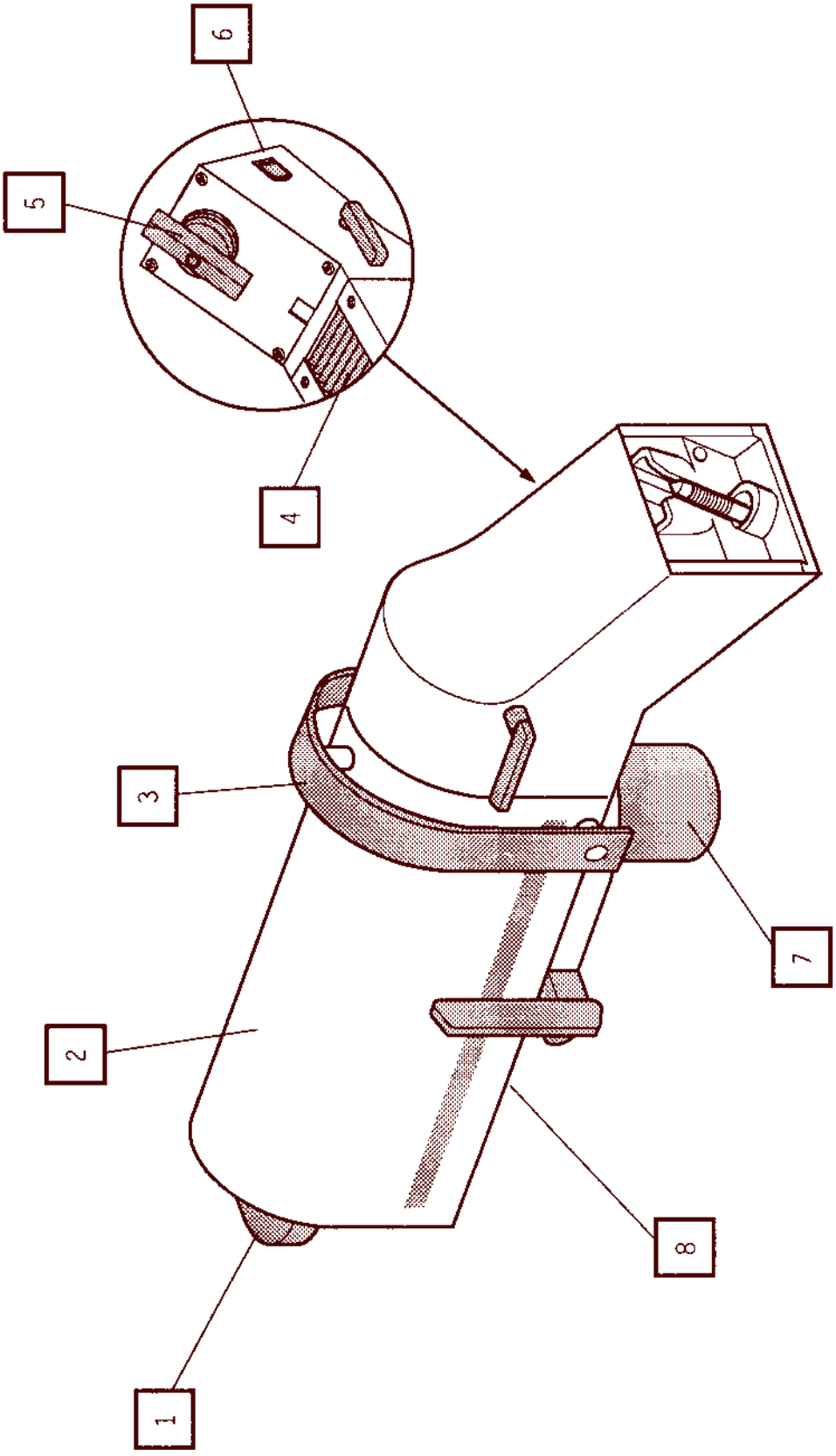
Nr.	Inspection station Designation	Symbol/ position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
3 3.1	**Stroke column** Drive belt	1	Protective cap of the drive belts dismantle. The drive belt for perfect condition and for attachment check.			Annually
3.2	Guard plate drive belt	2	Guard plate drive belt for damages check and again at the column install.			Annually
3.3	Protective engine hood	3	Check for perfect attachment and for damages.			Annually
3.4	Engine crank handle	4	Check their perfect function by turn of the engine crank handle. During the turn to both locking knobs pay attention.			Annually
3.5	Covers	5	Check for perfect attachment and for damages.			Annually
3.6	Handle	6	Check for perfect attachment and for damages.			Annually


4
3
5
6
5
6
1
2

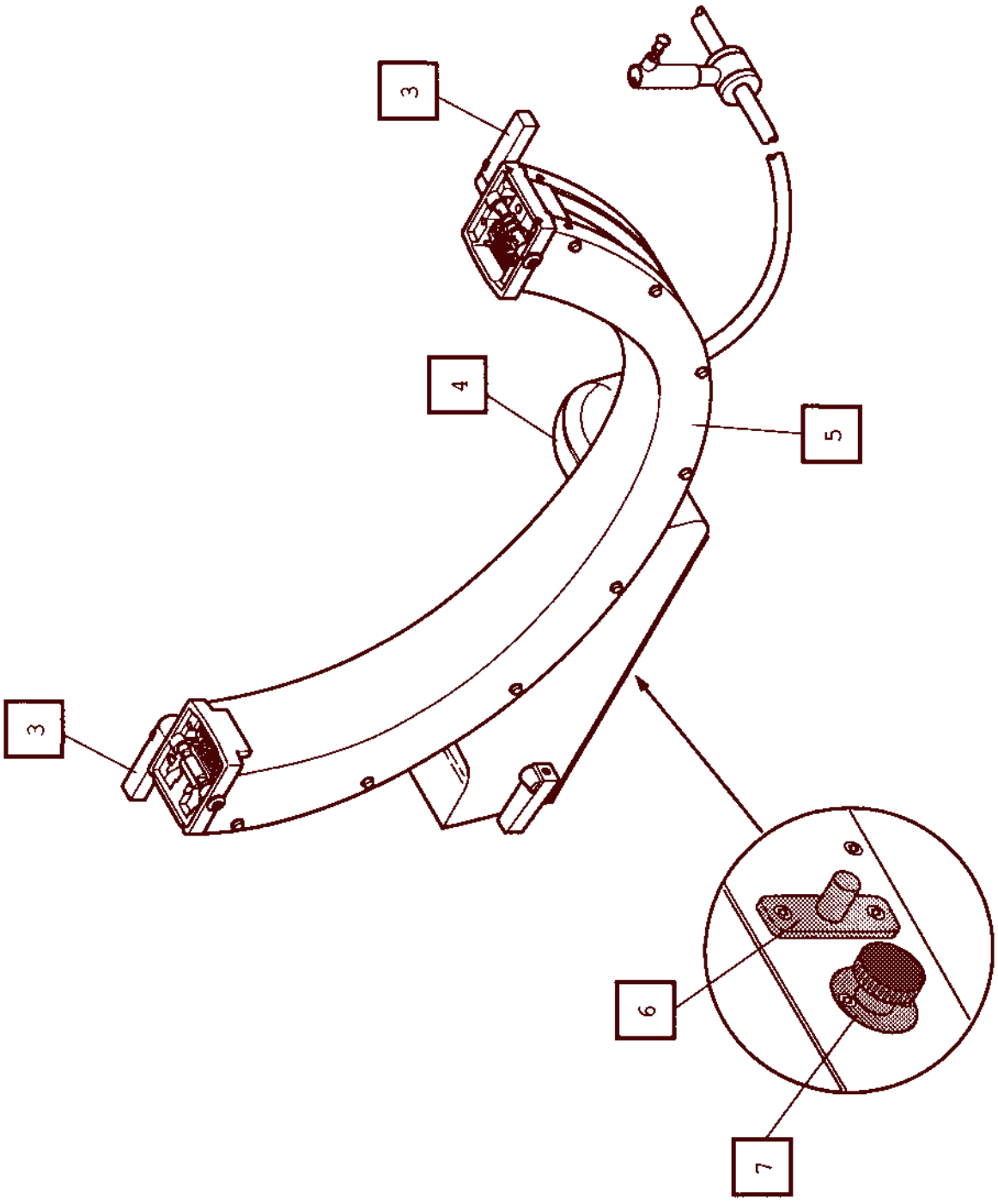
Nr.	Inspection station/ Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
4 4.1	**Electronics block** Mounting plate for Collimator	**8**	Collimator install, which check perfect mounting plate.			Annually
4.2	Cable support	**6**	Cable supports for perfect attachment and for damages check.			Annually
4.3	Mains connection cable	**7**	Mains connection cables for perfect attachment and for damages check.			Annually
4.4	Kick strip plate	**1**	The kick strip plate for perfect attachment and for damages check.			Annually
4.5	Cover	**3**	The cover for perfect attachment and for damages check.			Annually
4.6	Hand switch	**4**	The hand switch with connecting cable for damages check.			Annually
4.7	Foil keyboard	**5**	The foil keyboard for cleanliness and perfect condition check.			Annually


7
6
3
8
5
4
3
2
1

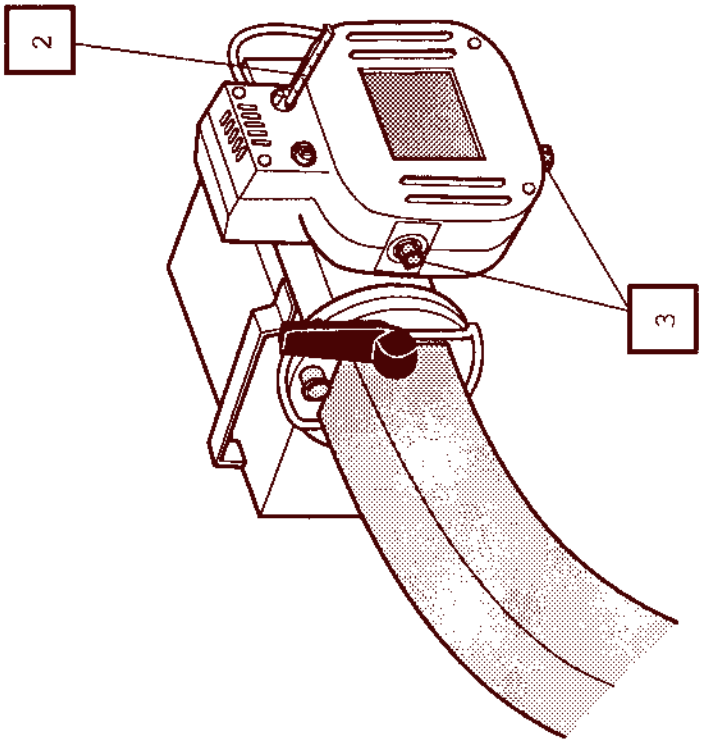
Nr.	Inspection station/ Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
5	**C-arm bracket**					
5.1	Handle	3	The handles for perfect attachment and for damages check.			Annually
5.2	Covers	2	The covers for perfect attachment and for damages check.			Annually
5.3	Protection socket	7	The C-arm bracket onto the stroke column install and the function of the protection socket check.			Annually
5.4	Bellows for forward and backward movement	4	The bellows for forward and backward movement for perfect attachment and for damages check.			Annually
5.5	Camps for forward and backward movement	8	For forward and backward movement without jerking check.			Annually
5.6	Locking lever	5	C - arm install and the function of the locking lever check.			Annually
5.7	Unlocking button	6	The function of the unlocking button check.			Annually

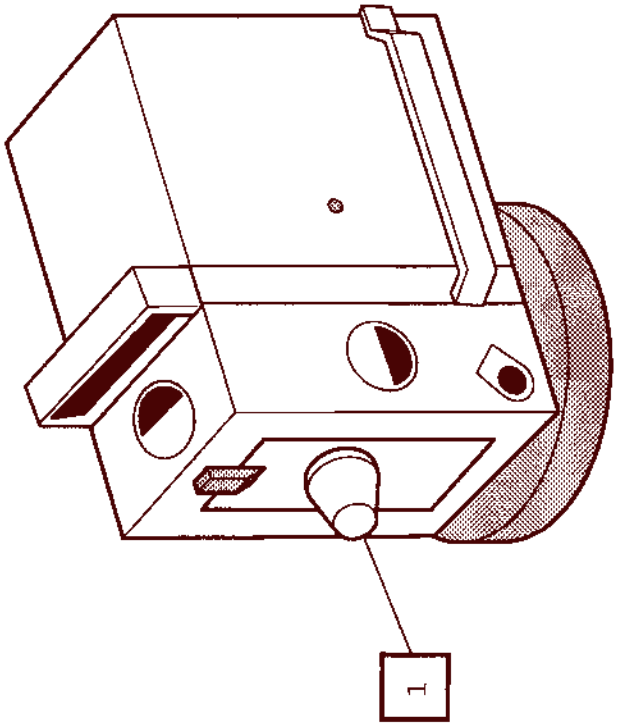

6
5
4
3
7
2
8
1

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
6 6.1	**C-arm** Transportation barrier	7	The transportation barrier for perfect attachment and for damages check.			Annually
6.2	Cable entry	4	The cable entry at the C - arm for perfect attachment and for damages check.			Annually
6.3	Cable suspension	6	The cable suspension for perfect attachment and for damages check. The C-arm cable install and the function of the safety lock pins check.			Annually
6.4	Camps		The C - arm shift at several times and the perfect run check.			Annually
6.5	Pushbuttons for sterile cloth cover	5	Sterile cloth cover at the C – arm install and the perfect function of the pushbuttons check.			Annually
6.6	Locking levers with safety lock pins	3	Image intensifier unit and X-ray source install and the function of the locking levers and safety lock pins check.			Annually

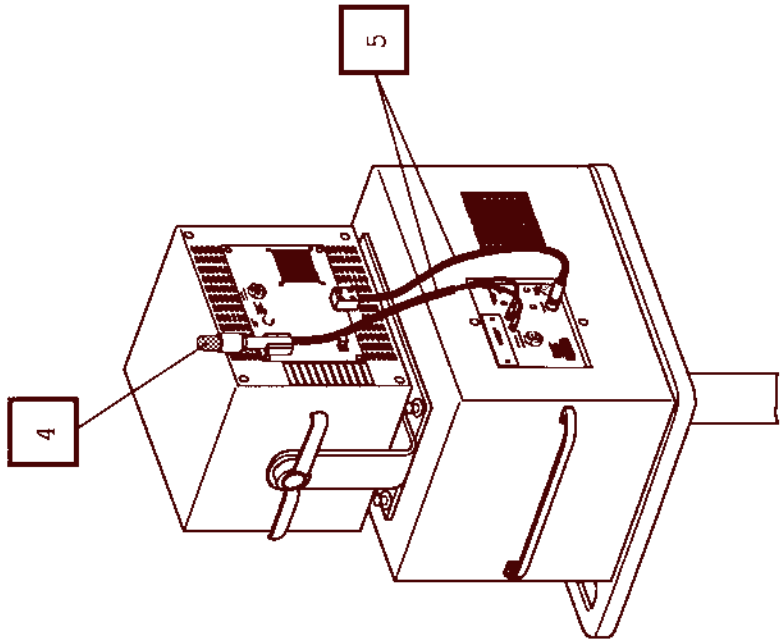

3
4
5
3
6
7

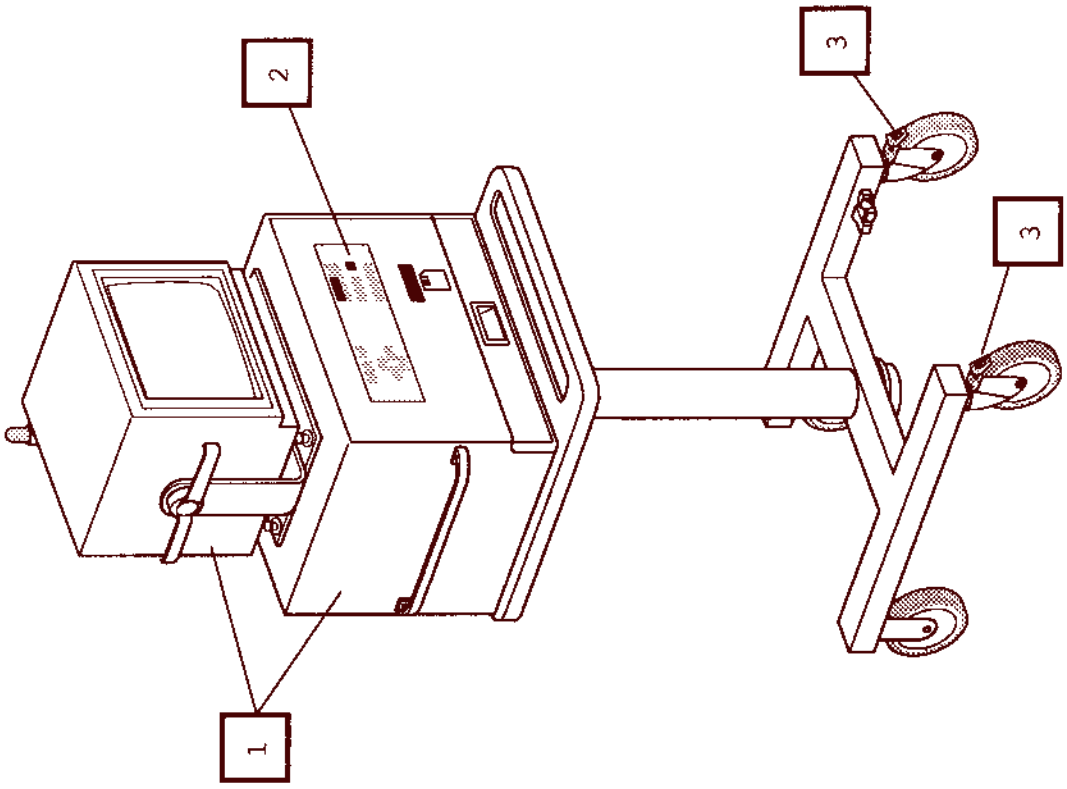
Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
7	**X-ray source**					
7.1	Fluoroscopy tubus	1	The installed Fluoroscopy tubus for tightness and perfect attachment check.			Annually
8	**Collimator**					Annually
8.1	Tape measure	2	The tape measure completely pull out and the function of the determination mechanism check			
8.2	Control elements	3	All control elements for perfect condition and function check.			Annually


2
3


1

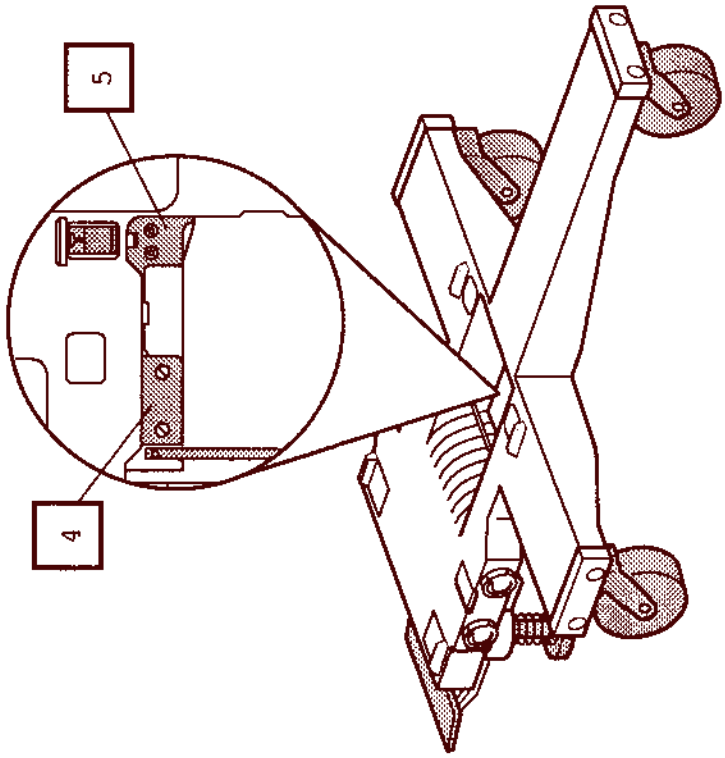
Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
9	**Display unit**					
9.1	Housing parts	1	All housing parts for transport damages such as depressions, tears, breaks or damages of lacquer check.			Annually
9.2	Connecting cables	5	Cables and connectors for damages and contamination. check			Annually
9.3	Foil keyboard	2	For cleanliness and perfect condition check.			Annually
9.4	Radiation indicator	4	Fixing of the connecting cable check.			Annually
9.5	Clamp at the parking brake on the basic frame	3	Parking brake clamp for function check.			Annually

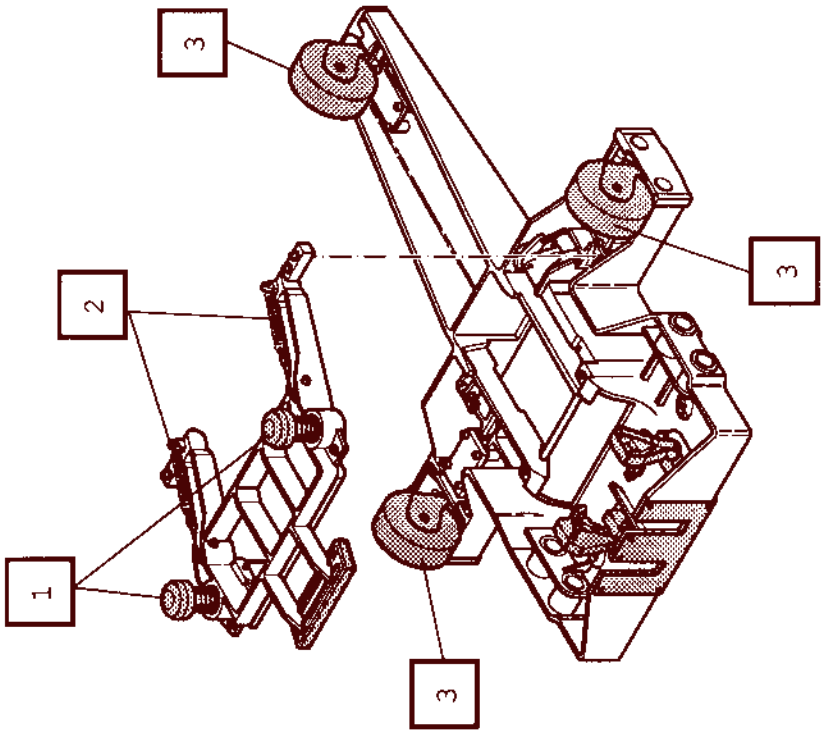

5
4


2
3
3
1

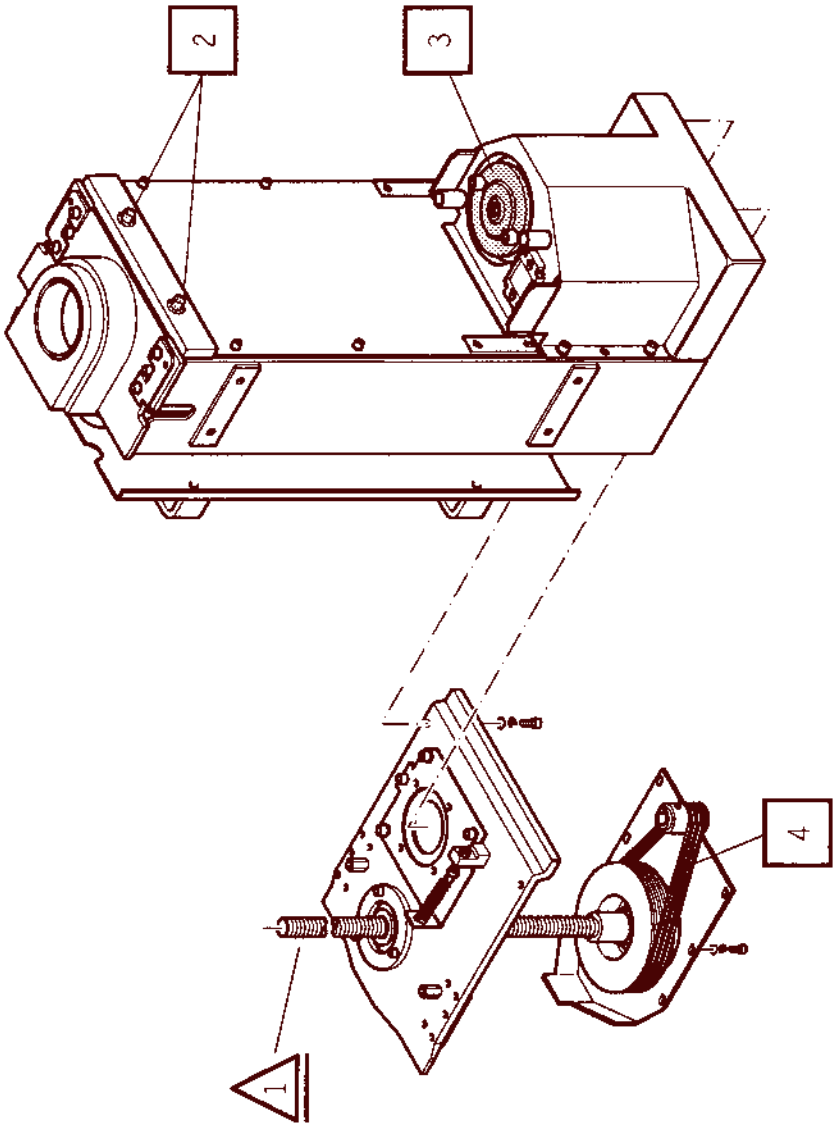
2.12.2.2 Period work on the "stored equipment"

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
1	**Chassis X - ray unit**		The chassis with the wheels on the soil put **upward** to check and for corrosion and eliminate if necessary.			two-annually
1.1	Wheels	**3**	Function of the wheels (light run, lagging). check			two-annually
1.2	Brake shoe	**1**	For perfect attachment and for damages. check			two-annually
1.3	Wire rope with spring	**2**	For perfect attachment, corrosion and for damages.			two-annually
1.4	Guide plate	**4**	The chassis with the wheels **downward** on the soil and the guide plate for perfect attachment and for damages check.			two-annually
1.5	Click-stop device for column	**5**	The function of the click-stop device check, two-annually			two-annually

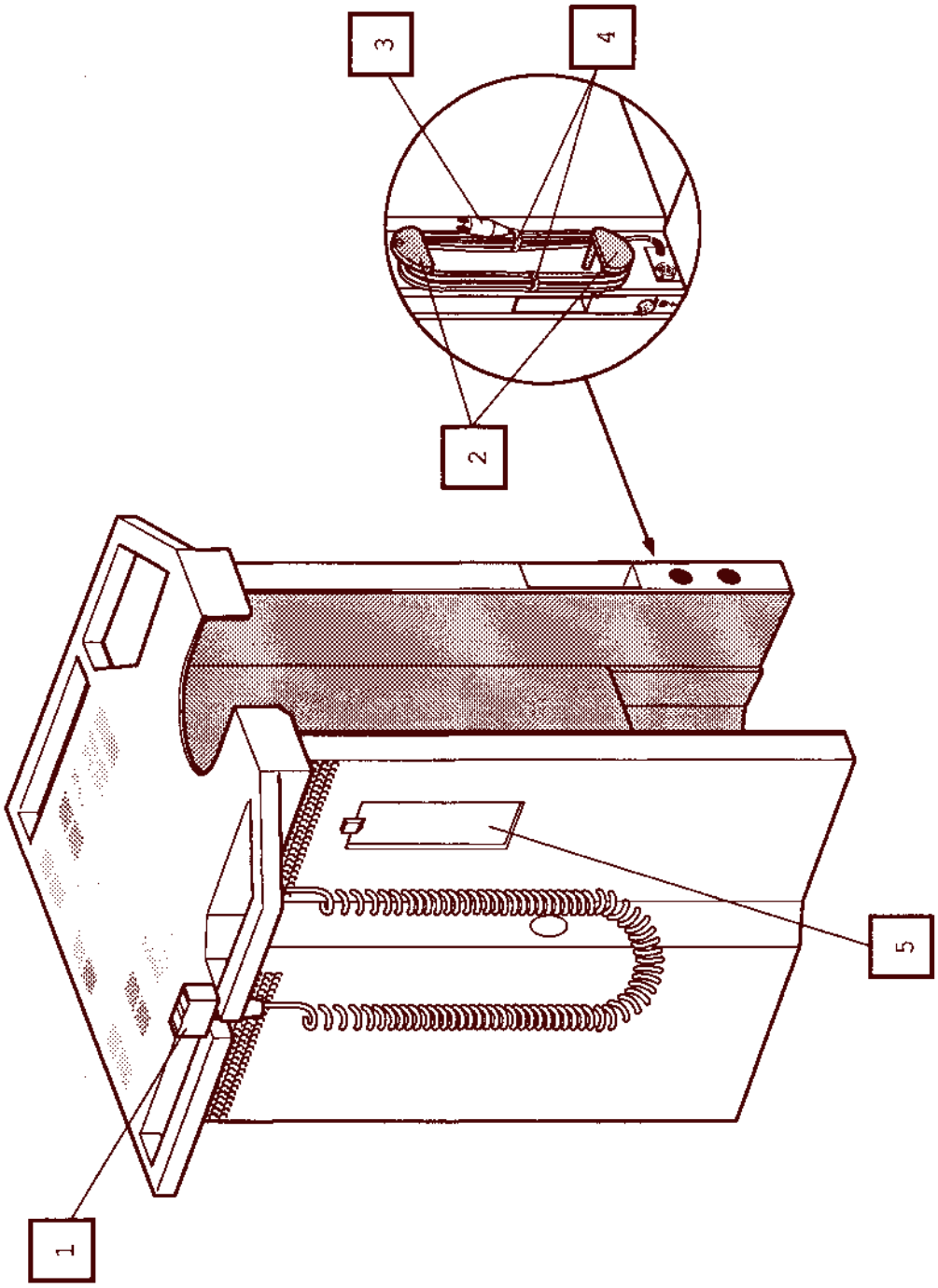

5
4


3
2
3
1
3

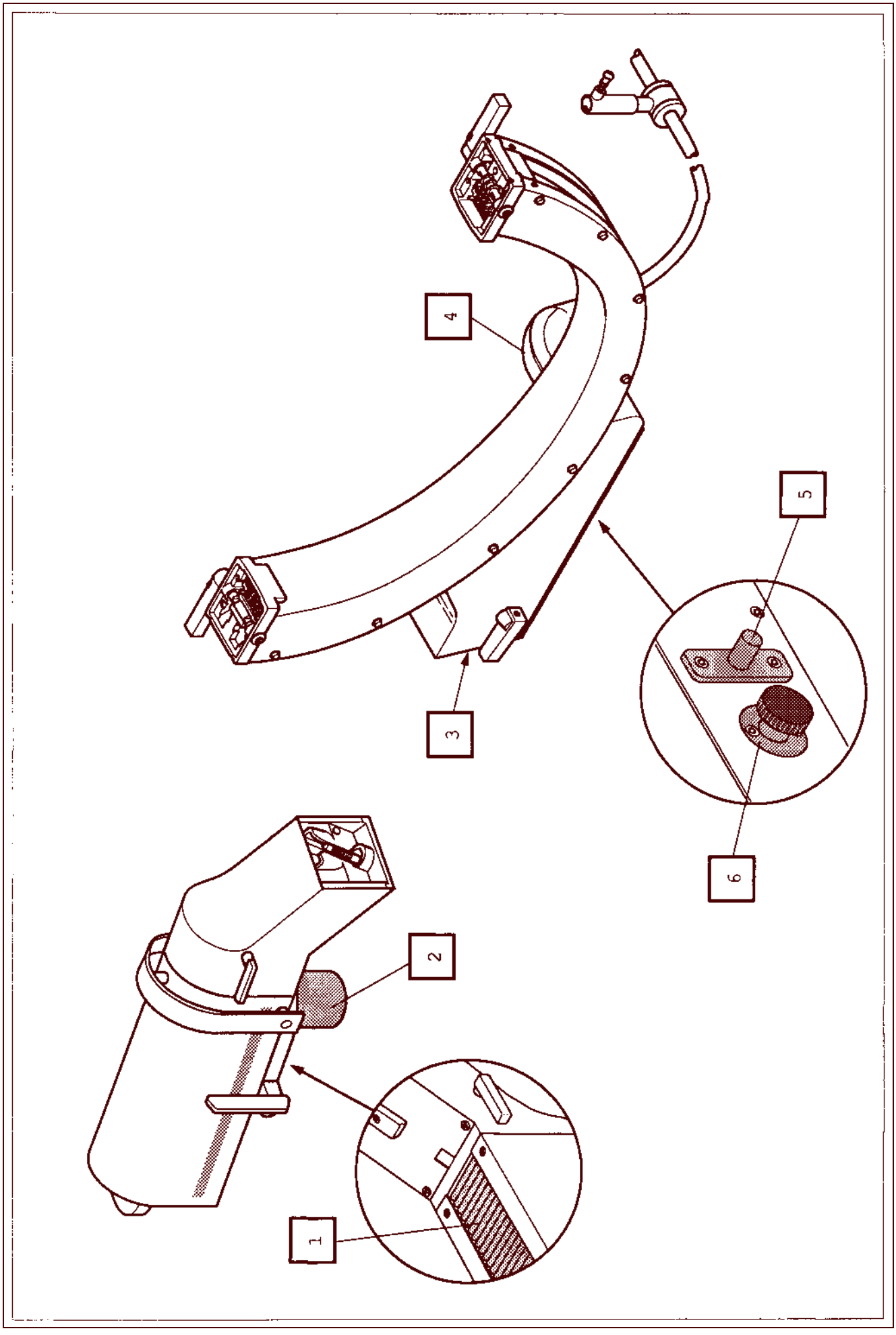
Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
2	**Stroke column**		The stroke column turn off and for corrosion check and if necessary eliminate.			two-annually
2.1	Drive belt	4	Remove protective cap drive belt. The drive belt for perfect condition and attachment check.			two-annually
2.2	Spindle/nut and guide rails	1	Protective engine hood remove. Spindle/nut and guide rails for perfect condition, corrosion and cleanliness examining. Spindle and nut cleaning and oiling. It may not arrive oil at the guide rails!			two-annually
2.3	Engine crank handle	3	Through rotate of the engine crank handle their perfect function check. Those stroke column turn with crank handle completely upward and cleaning Subsequently, rotate back again.			two-annually
2.4	Engaging for the electronic box	2	Engaging for the electronic box for perfect condition and function check.			two-annually


2
3
4
1

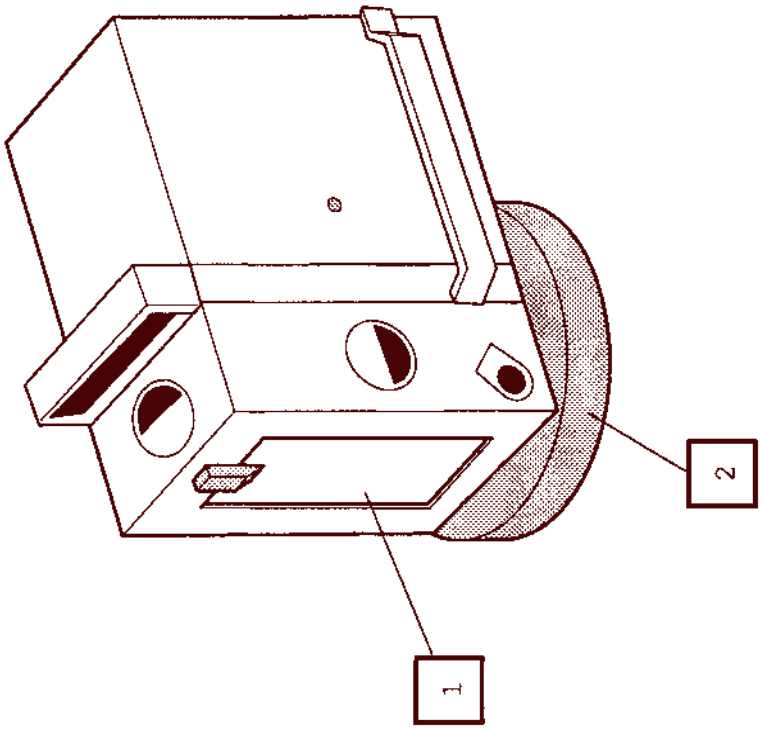
Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
3	**Electronic block**		The electronics block turn off and for corrosion check and if necessary eliminate.			two-annually
3.1	Mounting plate for collimator	**5**	Mounting plate for condition and function check.			two-annually
3.2	Cable support	**2**	Cable supports for perfect attachment and for damages check.			two-annually
3.3	Belt for cable attachment	**4**	Belt for cable attachment for perfect attachment and for damages check.			two-annually
3.4	Mains connection cables with plug	**3**	The mains connection cable for damages check.			two-annually
3.5	Hand -/double foot switch	**1**	The hand/double foot switch for damages check.			two-annually

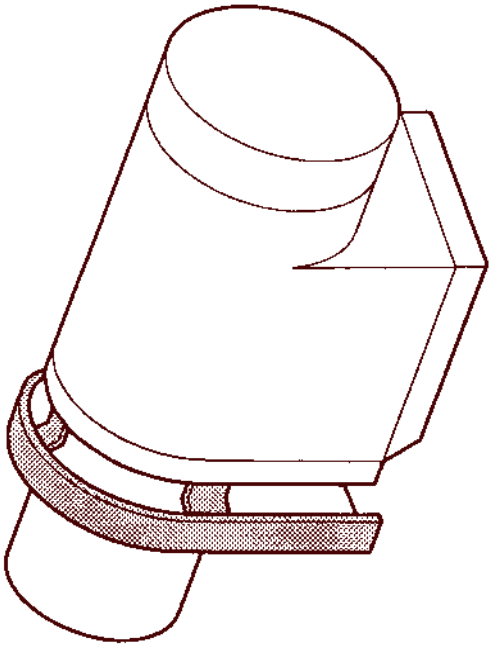

3
4
2
5
1

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
4	**C-arm bracket**		The C-arm bracket placing down and for corrosion check and if necessary eliminate.			two-annually
4.1	Protection socket	**2**	Condition and function of the protection socket check.			two-annually
4.2	Bellows for forward/backward movement	**1**	The bellows for forward /backward movement for perfect attachment and for damages check.			two-annually
5	**C-arm**		the C - arm placing down and for corrosion check and if necessary eliminate.			two-annually
5.1	Transportation barrier	**6**	The transportation barrier for perfect attachment and for damages check.			two-annually
5.2	Cable entry	**4**	The cable entry at the C - arm for perfect attachment and for damages check.			two-annually
5.3	Cable suspension	**5**	The cable suspension for perfect attachment and for damages check. The C-arm cable install and the function of the safety lock pins check.			two-annually
5.4	Mechanical connections with the C-arm bracket (bolting device)	**3**	Mechanical connections with the C-arm bracket for perfect attachment and for damages check			two-annually

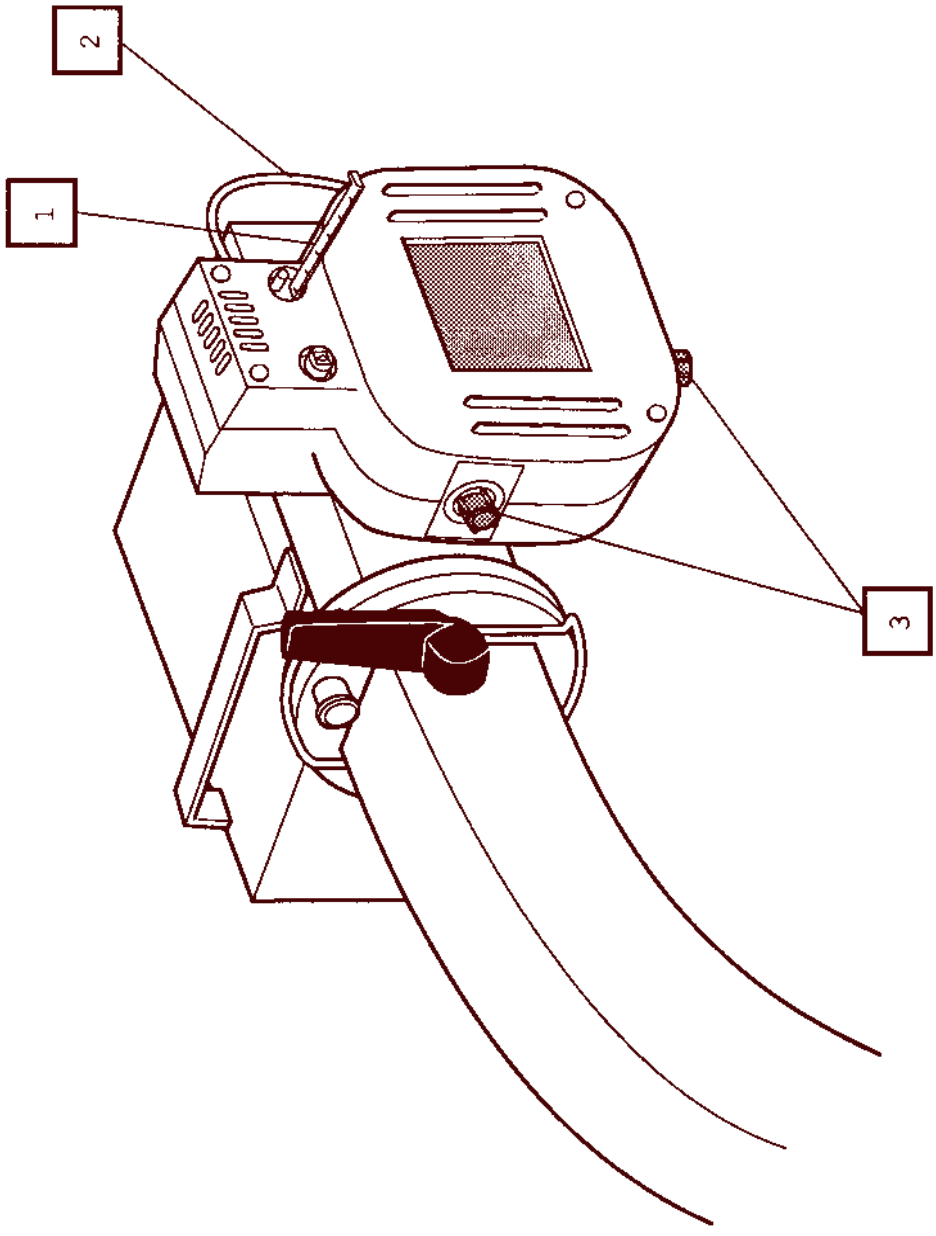

4
5
3
6
2
1

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
6	**Image intensifier unit**		The Image intensifier unit placing and for corrosion check and eliminate if necessary.			two-annually
6.1	Locking levers and safety lock pins		Locking levers and safety lock pins for perfect attachment and for damages check.			two-annually
7	**X-ray source**		The X-ray source placing and check for corrosion and eliminate if necessary.			two-annually
7.1	Locking levers and safety lock pins		Locking levers and safety lock pins for perfect attachment and for damages check.			two-annually
7.2	Turning mechanism	**2**	Turning mechanism for perfect attachment and for damages check.			two-annually
7.3	Clutch admission for collimator etc..	**1**	Clutch admission for collimator, fluoroscopy -, dental and getter tubus for perfect function check.			two-annually

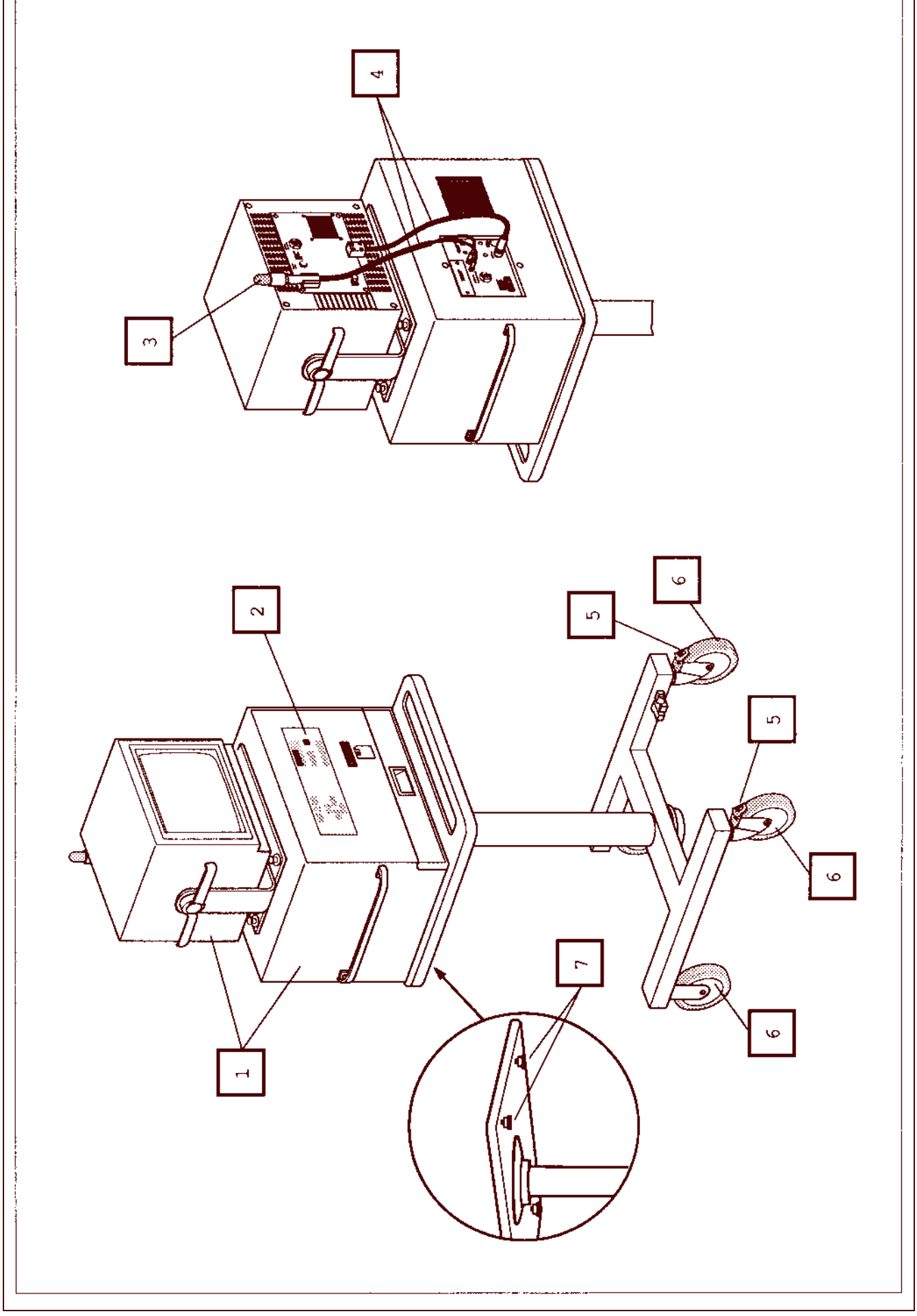

2
1



Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
8	**Collimator**		The collimator placing down and for corrosion check and if necessary eliminate.			two-annually
8.1	Connecting cable with plug	**2**	Connecting cable and plug for perfect condition check.			two-annually
8.2	Tape measure	**1**	The tape measure completely pull out and the function of the locking mechanism check.			two-annually
8.3	Control elements	**3**	All control elements for perfect condition and function check.			two-annually
9	**Double foot switch**		For outside damages and cleanness check.			two-annually


2
1
3

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
10	**Display unit**					
10.1	Housing parts	1	Check all housing parts on transport damages, like depressions, tears, breaks or damages of lacquer.			two-annually
10.2	Connecting cable	4	Check all cables and connectors for damages and contamination.			two-annually
10.3	Foil keyboard	2	For cleanliness and perfect condition check			two-annually
10.4	Radiation indicator	3	Fixing of the connecting lead check			two-annually
11	**Basic frame**	6				
11.1	Wheels at the basic frame		Function of the wheels (light run, lagging). Check			two-annually
11.2	Clamp at the parking brake on the basic frame	5	Parking brake clamp for function check.			two-annually
11.3	Fixing bolts on the basic frame	7	Fixing bolts on the basic frame for perfect condition and function check..			two-annually


4
3
6
5
2
5
6
7
6
1

Nr.	Inspection station Designation	Symbol Position number	Test/Activity	Desired value Lubricant	Reference to side	Time of the work
1	2	3	4	5	6	7
12	**X - ray system**		Assembling the X - ray system			two-annually
12.1			Burn in procedure in accordance with 2.5 accomplish.		85	two-annually
12.2			Function checks in accordance with 2.4 accomplish.		71	two-annually

2.12.3 Description of the maintenance work

Like each technical equipment apart from appropriate operation regular maintenance and servicing.

By these precaution measures the operating ability and working reliability of the system will maintain.

This X-ray system contains mechanical elements such as driving chains, rope, steel strips and transmissions, which are subject to a operating conditioned wear.

The correct settings or adjustments in the X-ray system electromechanical and electronic building groups easily present has influence on the operability, the attainable image quality, electrical security as well as on the radiation exposure of patients and medical personnel.

2.12.3.1 Cleaning

Before the cleaning of the X-ray system the power plug must be disconnected from mains.

Make sure that no liquids arrive into the inside of the X-ray system. Thus short-circuits in the electrical installation and corrosion at construction units are avoided.

Painted parts and aluminium surfaces with a damp cloth and mild cleaning agents wipe and with a dry wool cloth finish-ream.

No corrosive, solving or sharpening cleaning or polishing agents use.

Chromium-plated parts only with a dry wool cloth abrade.

2.12.3.2 Disinfection

Before the disinfection is the X – ray system to clean easily.

REFERENCE No disinfectants may be used on phenol basis.

All parts of the X-ray system including the accessories and the cable connections only of a wiping disinfection submit. No corrosive or solving disinfectants use.

Gaseous disinfectants may not be used.

A spraying disinfection is forbidden, since here disinfectants can penetrate into the X-ray system.

If a room disinfection is to be made by a nebulizer, the X - ray unit carefully cover. It switches the x-ray unit off, before and leaves cooling, in order to avoid that through developing hot air stream droplets arrive in the inside.

After dropping the disinfection fog the covers can be removed and the X-ray system a wiping disinfection be submitted.

The applied disinfection method must correspond to the valid legal regulations and guidelines for disinfection and to the explosion prevention.

2.13 Trouble, Error, Reason, Repairing

2.13.1 Introduction

Trouble/error messages is represented at the electronics block and at the bit map memory unit.
The trouble/error messages at the electronics block are arranged into two groups.

- Not ready - conditions
- Alarm message

"Not ready" - conditions in the normal operation (e.g. after switching on) and are not necessarily to errors in the system to be due. The lamp over the power on switch shines constantly, but X - ray is not possible.

"Alarm" - messages are to be always due to errors. The lamp over the power on switch flashes and X-ray is not possible.

Error messages at the bit map memory unit are accompanied by an audio signal. They are self-describing and appear for approx.. 10 s left down in the screen picture. During this time X - ray is not possible.
After that approx.. 10 s the entered, however not executable action is broken off.

REFERENCE

Appears at the screen picture the error message “APPARATEFEHLER” it means Apparatus error, then the bit map memory unit is to be switched off immediately and delivered for repair.

The available "Nicht bereit” it means “not ready” - conditions can be represented with the diagnostic switch as code in the indication area for fluoroscopy time.

Approx.. 30 s after switching on should be all " not ready" - conditions deleted.
Otherwise an error is present.

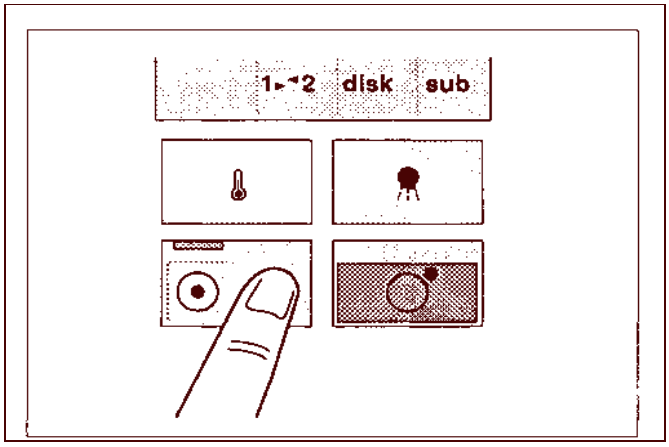


Fig. 178

2.13.1.1 Lamp test

By simultaneous pressing of the switching on push button and the diagnostic push button a test of all lamps and indication areas is accomplished.

All lamps shine and all places of the indication areas become as "1" and/or. "8" represented. In the indication area for fluoroscopy time the error code 1-9 is represented.

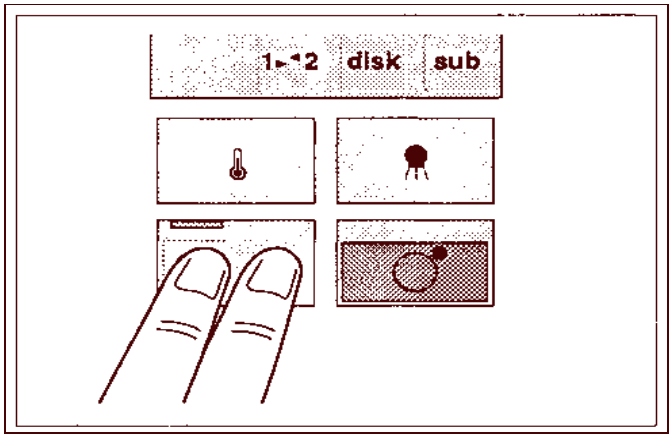


Fig. 179

2.13.1.2 Fuse test/changes

Within the lower area of the opened electronics block are six micro fuses placed.

The cover of the electronics block after loosening of the screws open unfold.

F1 = Input 220 V AC
F2 = Input 220 V AC

F3 = Output 12V AC for collimator
F4 = Output 12 V AC for collimator

F5 = Output 230 V AC internal and bit map memory unit
F6 = Output 230 V AC internal and bit map memory unit

The desired fuse after screwing the fuse holder on take out and at the fuse tester at the bit map memory unit (backside) check.

The fuse with the metal surfaces, which can be examined, by holding at the contact areas of the fuse tester.

LED shines: fuse not defective.

Defective fuses have to be replaced.

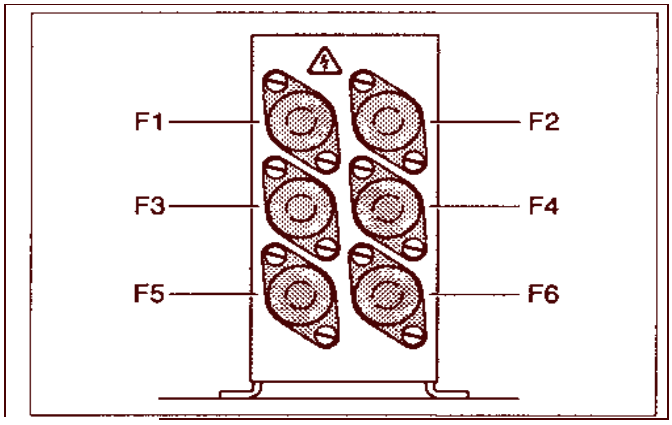


Fig. 180

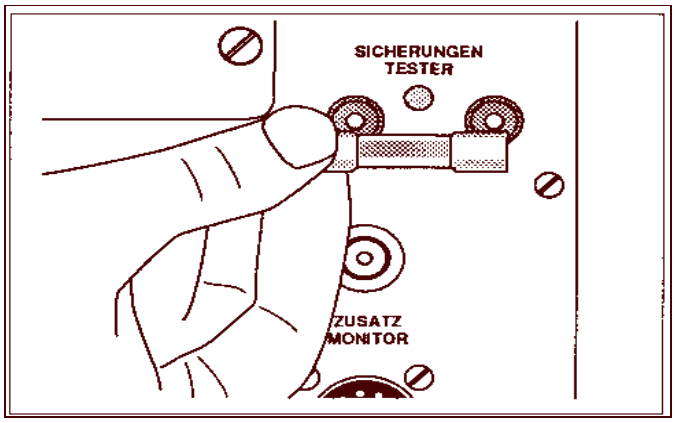


Fig. 181

2.13.1.3 Light emitting diodes (LED)in the mains control circuit

Beside the fuses are installed the two PCB´s of main power control.

The left PCB is equipped with two light emitting diodes (LED).

LED green	=	mains voltage present
LED red	=	main power control faulty

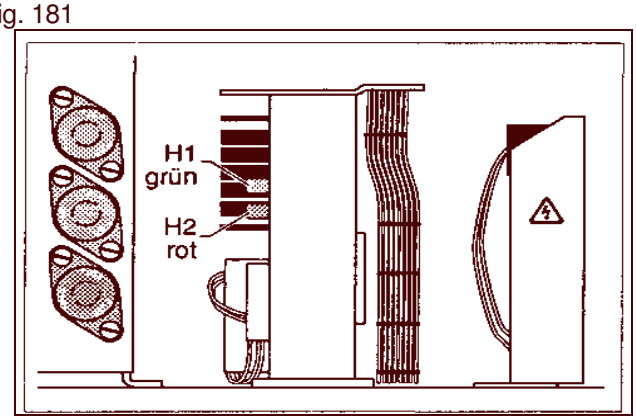


Fig. 182

2.13.1.4 Fuse of the bit map memory unit

The equipment fuse of the bit map memory unit is placed under an unscrew able metal plate at the rear wall.

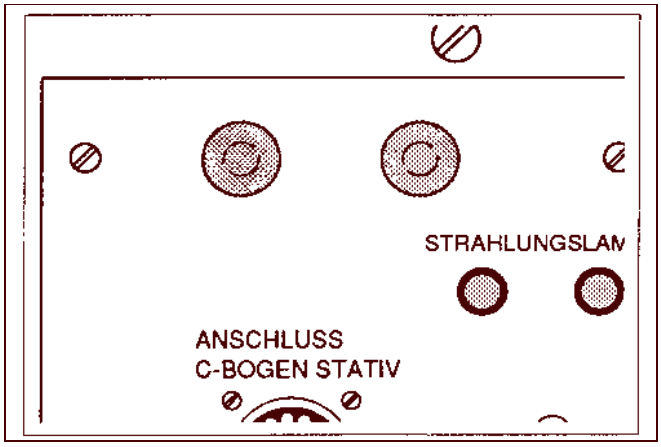


Fig. 183

2.13.1.5 Fuse testers at the bit map memory unit testing

1. Bit map memory unit disconnect from mains.

2. With a screwdriver the two metallic contacts of the fuse tester connect for a short time (LED shines).

ATTENTION This test may be accomplished only for a short time!

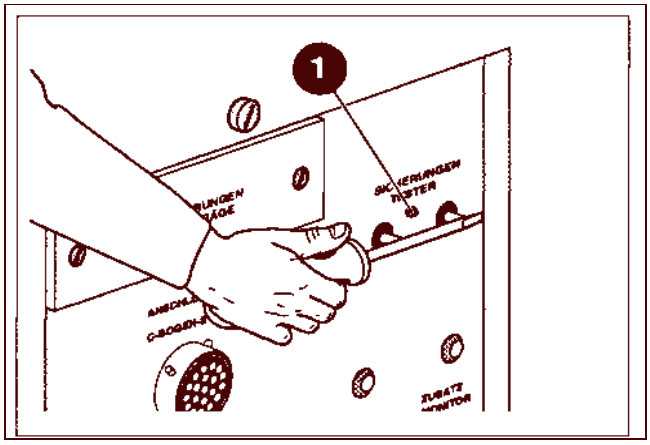


Fig. 184

2.13.2 Listing of the faults or troubles after switching on (fluoroscopy on)

Fault/Trouble	Reason	Repairing
X - ray unit cannot be switched on	Mains voltage is missing	Mains connection check.
		Green LED H1 (WA1) in the electronics block check.
	LED off	Fuse F1 and F2 in the electronics block check if necessary replace
		Electronics block replace.
	LED shines	Fuse F5 and F6 in the electronics block check if necessary replace.
	Loop monitoring check	Connectors C-arm cable, the image intensifier unit, the X-ray source and the column drive check.
		Electronics block replace
Lamp over the “Power on” switch flashes	"Alarm" message	Flashing "alarm" - message reading.
No "alarm" message appears	Main power monitoring in the electronics block faulty.	Electronics block replace.
Message "Error 1" flashing	HV – generator in the image intensifier faulty	Image intensifier replace.
		Electronics block replace.

Fault / Trouble	Reason	Repairing
"Error"-2,3oder 5 flashes	X-ray source faulty	X-ray source replace
	Bit map memory unit faulty	Bit map memory unit replace
	C - arm faulty	C - arm replace
"Error" - 6, 7 or 8 flashes	Electronics block faulty	Electronics block replace
Lamp "fluoroscopy" out	Fluoroscopy not selected	Check lamp "Aufnahme" (Radiography); if lamp "Aufnahme" likewise out: Electronics block replace.
	Cable connections faulty	Cable connection check.
	X-ray source not in zero position	X-ray source turn or replace.
Lamp "fluoroscopy" out	DL -Tubus wrongly installed	DL - Tubus correctly installing
	Electronics block faulty	Electronics block replace
	C-arm cable faulty	C - arm replace
KV display darkly or # 40	Electronics block faulty	Electronics block replace
mA display darkly or # 0.1	Electronics block faulty	Electronics block replace
Min display darkly or # 00.0	Electronics block faulty	Electronics block replace
On the display unit no memory bars are visible	Display unit not switched on	Display unit switched on
	Cable connections faulty	Cable connections check
	Bit map memory unit faulty	Bit map memory unit replace
	Electronics block faulty	Electronics block replace
The diskette trace display on the bit map memory # 00	Bit map memory unit faulty	Bit map memory unit replace
Memory display incorrectly	Bit map memory unit faulty	Bit map memory unit replace
	Electronics block faulty	Electronics block replace
Lamp for brightness/contrast automatic at the bit map memory unit is out	Brightness and/or contrast individually adjusted	Both brightness tracers or both contrast tracers press telex display terminal at the same time
	Display unit faulty	Display unit replace
	Bit map memory unit faulty	Bit map memory unit replace

2.13.3 Listing of the troubles floppy disk / bit map memory unit

Fault / Trouble	Reason	Repairing
No floppy disk drive assembly control after inserting a floppy disk	Floppy disk drive faulty Bit map memory unit faulty	Floppy disk drive or Bit map memory unit replace
Floppy disk cannot be formatted	Floppy disk faulty Floppy disk drive faulty Bit map memory unit faulty	Insert a other disk Floppy disk drive replace Bit map memory unit replace
Mask number is not indicated in the recording procedure to Error message "Floppy disk secured" or "Floppy disk full " appears on the screen	Floppy disk Bit map memory unit faulty Cable connection faulty	Insert a other disk Bit map memory unit replace Cable connections to the X - ray unit replace
Picture is not written on floppy disk	Floppy disk faulty Bit map memory unit faulty Cable connection faulty Electronics block faulty	Need a other disk trace Bit map memory unit replace Cable connection to the X - ray unit replace Electronics block replace
Lamp "Disk" at the electronics block does not shine	Electronics block faulty	Electronics block replace
Picture display incorrectly	Bit map memory unit faulty	Bit map memory unit replace
Not to reading the picture from floppy disk	Floppy disk faulty Bit map memory unit faulty	Insert a other floppy disk Bit map memory unit replace
Picture from floppy disk on the screen not perfectly	Floppy disk faulty Bit map memory unit faulty	Insert a other floppy disk Bit map memory unit replace

2.13.4 Listing of the troubles when fluoroscopy

Fault / Trouble	Reason	Repairing
No radiation display after fluoroscopy release, but the lamp over the power on switch shines constantly	X - ray unit is not ready for use	Diagnostic push button operate and "not ready" condition do release.
- None "not ready" – message	Release switch faulty	Release with other switch repeat.
- "Error" 1	High voltage primarily faulty	Electronics block replace
- "Error" 2	Display unit faulty	Electronics block replace
- "Error" 3 o. 9	Tubus wrongly installed	Tubus in accordance with instruction installing.
	X-ray source screwy (not in the zero position)	X-ray source aligns.
	C - arm faulty	C – arm replace
- "Error" 4	Bit map memory unit faulty	Cable connections to the bit map memory unit remove and directly in the display terminal attaches. If errors repaired, bit map memory unit replace. If errors did not repair, electronics block or cable connections replaces
- "Error" 5, 6, 7, 8	Electronics block faulty	Electronics block replace
No radiation announcement after fluoroscopy release and the lamp over the “Power on” switch flashes.	X - ray unit is faulty	"Alarm" message release
- No “Alarm "- message present	Mains controller faulty	Electronics block replace
- " Error” 1 flashes	Image intensifier HV generator unit faulty	Image intensifier unit replace
- "Error" - 2 o. 3 flashes	X - ray generator faulty	X-ray source replace
	Electronics block faulty	Electronics block replace
- "Error" -4, 6, 7 or 8 flashes	Electronics block faulty	Electronics block replace

Fault / Trouble	Reason	Repairing
"Error"5 present	X-ray source temperature too high X-ray source faulty Electronics block faulty	Let the X-ray source cooling down to lower then 68 °C X-ray source replace Electronics block replace
kV and mA values on the display runs high to 105 kV or. 3.1 mA	Connection faulty Electronics block faulty C - arm faulty	Cable connection directly with the display (monitor) connect. If error repaired, bit map memory unit replace. If error did not repair, electronics block or cable connection replaces Electronics block replace C arm replace.
No fluoroscopy picture on the display unit present	Electronics block faulty Bit map memory unit faulty C-arm cable faulty	Electronics block replace Bit map memory unit replace C - arm replace
kV and mA-display regulates not to a stable value	Electronics block faulty	Electronics block replace
Fluoroscopy picture not error free	Image intensifier unit faulty Bit map memory unit faulty Electronics block faulty	Image intensifier unit replace Bit map memory unit replace Electronics block replace
Fluoroscopy timer don't counts or stops	Electronics block faulty	Electronics block replace
Picture insertion on the display unit not possible	Screen in the X – ray source faulty Electronics block faulty	X-ray source replace Electronics block replace
Picture inversion on the display unit not possible	Image intensifier unit faulty Electronics block faulty	Image intensifier unit replace Electronics block replace
Picture rotation on the display (monitor) not possible	Electronics block faulty or Connection cable faulty Display (monitor) faulty	Picture rotation directly at the display (monitor) check AC, if turn possible Electronics block replace Connection cable replace If turn not possible: display (monitor) replace

Fault / Trouble	Reason	Repairing
The last fluoroscopy picture became after releasing the hand or double foot switch not store/represented	Function hand or foot switch faulty Electronics block faulty Bit map memory unit faulty	Switch replace Electronics block replace Bit map memory unit replace
In the case of pulsed fluoroscopy no change between memory and fluoroscopy picture	Electronics block faulty Bit map memory unit faulty	Electronics block to replace Bit map memory unit replace
With snapshot no stored picture on the display (monitor) present	Bit map memory unit faulty Electronics block faulty	Bit map memory unit replace Electronics block replace
Radiation display remains after releasing the hand or double foot switch	Function hand or foot switch faulty Electronics block faulty Bit map memory unit faulty	Switches replace Electronics block replace Bit map memory unit replace
With stored picture is no video insertion on the display (monitor) possible	Bit map memory unit faulty	Bit map memory unit replace
Grainy picture on the display (monitor)	Bit map memory unit faulty	Bit map memory unit replace
Brightness/contrast regulation on the display (monitor) doesn't works correctly	Electronics block faulty Connection cable faulty Bit map memory unit faulty Display (monitor) faulty	Brightness/contrast adjusting on the bit map memory unit make. Error repaired: Electronics block replace Error remains: Connection cable replace Or Bit map memory unit replace Or Display (monitor) replace
No picture change with memory bank switching	Bit map memory unit faulty	Bit map memory unit replace

2.13.5 Listing of the troubles in radiography operation with cartridge holder

Fault / Trouble	Reason	Repairing
Lamp " Automatik-Aufnahme" (automatic exposure) doesn't shine	Change-over function faulty	Electronics block replace
KV display darkly or # 78 kV	APR automatic faulty	Electronics block replace
MAs display darkly or # 20 mAs	APR automatic faulty	Electronics block replace
APR LED´s do not shine	Electronics block faulty	Electronics block replace
No radiation display after 0,8 sec. release, but the lamp over the "Power on" switch shines constantly	X - ray unit is not ready for use	Diagnostic push button push and "not ready" condition read.
- None "not ready" – message	Release switch faulty	Hand or double foot switch replace.
- "Error" 1	High voltage primarily faulty	Electronics block replace
- "Error" 2	Display unit faulty	Electronics block replace
- "Error" 3 o. 9	Tubus wrongly installed	Tubus in accordance with instruction installing.
	X-ray source screwy (not in the zero position)	X-ray source aligns.
	C - arm faulty	C – arm replace
- "Error" 4	Bit map memory unit faulty	Cable connections to the bit map memory unit disconnect and directly in the display terminal attaches. If error repaired, bit map memory unit replace. If errors did not repair, electronics block or cable connections replaces
- "Error" 5, 6, 7, 8	Electronics block faulty	Electronics block replace
No radiation display. after 0,8 sec release and the lamp over the "Power on" switch flashes.	X - ray unit is faulty	"Alarm" message read
- No "Alarm "- message present	Mains controller faulty	Electronics block replace
- " Error" 1 flashes	Image intensifier HV generator unit faulty	Image intensifier unit replace
- "Error" - 2 o. 3 flashes	X - ray generator faulty	X-ray source replace

Trouble	Reason	Repairing
"Error" -4, 6, 7 or 8 flashes	Electronics block faulty	Electronics block replace
"Error"5 present	X-ray source temperature too high	Let the X-ray source cooling down to lower then 68 ℃
	X-ray source faulty	X-ray source replace
	Electronics block faulty	Electronics block replace
With end of the exposure the radiation indication remains, but no acoustic signal.	Electronics block faulty	Electronics block replace
Indicator/push button APR works not correctly	Electronics block faulty	Electronics block replace
APR display remains with hand operation	Electronics block faulty	Electronics block replace
With the program push button no other kV or mAs value can be selected	Electronics block faulty	Electronics block replace
Operation with collimator not possible or dental operation not possible	Collimator/Dental tubus wrongly installed	Collimator/Dental tubus in accordance with instruction installing.
	X-ray source faulty	X-ray source adjusting or replace
	Electronics block faulty	Electronics block replace
	C – arm faulty	C – arm replace
No density on the film material	Film development wrongly	Test film developing
	Film material wrongly	Foil or film controlling
	Cartridge wrongly inserted	Cartridge correctly insert
	X-ray source faulty	X-ray source replace
	Electronics block faulty	Electronics block replace

2.13.6 Listing of the troubles in radiography operation with collimator

Fault / Trouble	Reason	Repairing
Collimator lamp without function		Push buttons "light" operate once more again and controlling the push button lighting
	If push button lighting shines	Collimator lamp replace
	If push button lighting are off	Fuse 10 A (F3-F4) testing
	If fuse defectively	Fuse replace
	If fuse i. O., collimator faulty	Collimator replace
	X-ray source faulty	X-ray source replace
	C - arm faulty	C - arm replace
	Electronics block faulty	Electronics block replace
Collimator lamp remains longer than 1 min on	On timer in the collimator faulty	Collimator replace
Adjustment of the screens with the adjusting knobs not possible	Collimator faulty	Collimator replace
Operation of the collimator with table or cartridge stand not possible		Diagnostic push button operate and "not ready" condition read.
- None "not ready" – message	Clutch plate wrongly installed	Clutch plate check.
- "Error" 9	X-ray source faulty	X-ray source replace
kV display # 78 kV	APR automatic in the electronics block faulty	Electronics block replace
mAs announcement # 24 mAs	APR automatic in the electronics block faulty	Electronics block replace
Fluoroscopy is selectable	Mode of operation selecting in the electronics block faulty	Electronics block replace

2.13.7 Listing of the troubles in operation with Dental tubus

Fault / Trouble	Reason	Repairing
No dental operation possible - None "not ready" – message - "Error" - 9	 Clutch plate wrongly installed X-ray source faulty Electronics block faulty	Diagnostic push button release and "not ready" - message trigger Clutch plate check X-ray source replace Electronics block replace
X - ray unit did not automatically switch to hand operation with 0.2-12 mAs and fixed 60 kV	APR automatic in the electronics block faulty	Electronics block replace
Fluoroscopy is selectable	Mode of operation selecting in the electronics block faulty	Electronics block replace

2.14 Preservation and packing, storage

Preservation measures is not necessary for the storage of the duly packed X-ray system.
The packing is given by the containers belonging to the equipment.

2.14.1 Storage

The keeping/storage is generally only in dry, heat -, ventilated and as dust free rooms as possible to take place.

Temperatures in the stockroom: +12 °C to +25 °C

Air humidity (absolute): 3,0 to 12.0 g/m3

Air humidity (relative): 25 to 80 %

The X-ray system directly after a transport, which was accomplished at temperatures below -5 °C, to be stored, then the containers with locked covers are to be left in the stockroom until a temperature equalizing took place.
Subsequently, the containers are to be opened and possibly existing condensation water are to be eliminated.
The containers are to be locked then again and can now be stack/stored.

2.15 Transportation, transportation/dispatch

The X-ray system is packed into 8 stackable containers..

The total weight amounts to: 804 kg

The necessary utility space of all containers (not stacked) amounts to: 4,5 m²

For transportation and transport can be used appropriate handling equipments in accordance with joint service regulation as aids. For manual transport 2 persons are necessary.

2.15.1 Truck transport

In the case of truck transport is to be transported the containers in a traffic secure condition.

2.15.2 Air transport

The air transport of the packed x-ray system is possible for as interior load.

2.16 Technical safety and operational safety regulations

The x-ray system it's a transportable, not fixed attached, electrical medical equipment.

CAUTION X-ray radiation

For work with radiation and functional tests in the different kinds of structure is to be considered a safety margin more largely equivalent 2,5 m and carrying X - ray protective clothing (according to DIN 6813).

In accordance with the "principles for industrial safety of the professional association for health service and care of welfare" chapter V, point C, NR. 28 must be the usable electrical medical devices present, except before which first start-up at least regularly every 5 years are checking by an expert (e.g. TUEV).

2.16.1 Safety relevant checks

Check is to be accomplished in accordance with safety regulations for electrical medical devices.

2.16.1.1 Protective ground connection

The resistance between protective groundings, protective ground connection and the associated, contactable, conductive parts may not during removable supply line the following values exceed:

- without attached supply line < 0,1 Ohm
- with attached supply line < 0,2 Ohm

Test condition: 10 A <= I_{meas} <= 25 A U_{meas} < 6 V T_{test} > 5 s

2.16.1.2 Insulation resistance

The check takes an DC voltage with a value of 500 V. The following value must be achieved:

- Insulation resistance >= 2 MOhm

2.16.1.3 Tension strain

The high voltage must be practically sinusoidal with a frequency of 50 cps, applied for check,. Radio noise filters with y-capacitors can be disconnect. The test probes connected between power supply and housing.

The following high voltage must be applied:

- High voltage 1,6kV

2.16.1.4 Arrester discharge current

The check takes place via measurement of the arrester discharge current, which can flow from each pole of the system filter by or over the isolation by protective grounding to the earth.

The following value may not be exceeded:

- Equipment arrester discharge current =< 80 µA

2.16.2 Employment of the X-ray equipment in stationary medical establishment

With the employment of the X – ray system in stationary medical establishment the X - ray regulation is to be considered, § 19 "Controlled area". Those marking-describe are fixed in the joint service regulation.

2.16.3 Employment of the equipment under emergency-moderate conditions

The X - ray system knows within this range (e.g. schools, tents, cellar etc..) without restrictions to be used. The implementation instructions for X - ray regulation are to be considered.

2.16.4 Special regulations

The connection of the X - ray system may take place only at a earth contact -socket with 220 V - 50 cps. The electrical supply network must correspond to the VDE regulations (protective groundings). That applies both to line operation and to the operation with generator aggregates.

REFERENCE

Is the net resistance larger than 0.60 ohms, then the cable is to be strengthened.

Structure, start-up and functional test are to be accomplished only by the operator/user or special trained personnel.

Before all work on the electrical part of the X - ray system it is to be made certain that the power supply plug is disconnect from mains.

The developed X - ray system does not possess humidity protection. It must be protected therefore against splash-water.

2.16.5 Explosion prevention

The X - ray system corresponds to the anaesthesia central examination (AP according to DIN International Electronical Commission 601 part of 1/VDE 0750 part 1 main section 6) with intended use **without** collimator. The marking is laterally appropriate at the electronics block.

Display unit and bit map memory unit as well as the collimator arrive with intended use not into the range "medical environment" and are not manufactured therefore **not in** AP M realisation.

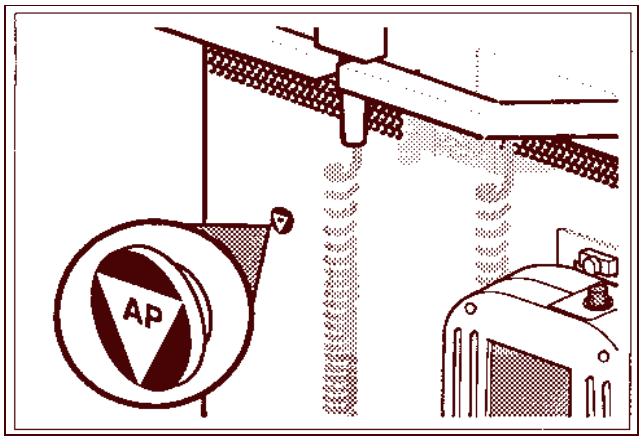


Fig. 185

2.16.6 Electrical security

The connection may take place only at earth contact -socket with 220 V - 50 cps.

REFERENCE Internal resistance must be have a value < 600 mOhm.

At a higher internal resistance can be have reduction of quality at the radiography and also at the fluoroscopy operation.

Only special trained personnel is it allowed to remove the cover from the HV - generator and to disconnect the HV cable between the X – ray source and the HV – generator.

The X - ray system may be operated only with attached protective grounding.

Before all work on the electrical part (also with up and dismantling), the cleaning and disinfection of the X - ray system, the power supply plug must be disconnect from mains.

The X - ray system is **not** intended for the operation in highly combustible ranges.
It is to be noted that cleaning and disinfectants can form combustible mixtures, which flew only be must, before the X - ray system is used again. Also with use of cleaning and disinfectants at the patient highly combustible ranges can develop.
The use of the X - ray system without intact optical and acoustic signal elements can endanger the patients as well as the operating personnel. Faulty function must be repaired immediately.

2.16.7 Potential equalization

The X - ray system is with two additional yellow/green potential equalization cable as accessories equipped. When examinations, for which the regulations require an additional potential equalization after VDE 0107 and EC 601-1, this potential equalization leader must be connected with the central potential equalization point of the examination room, the patient storage table (e.g. operation table) and the narcotic unit.

The connection point is on the right side of the electronics block underneath the female connector for the double foot switch.

The X - ray system may be operated only with attached protective grounding.

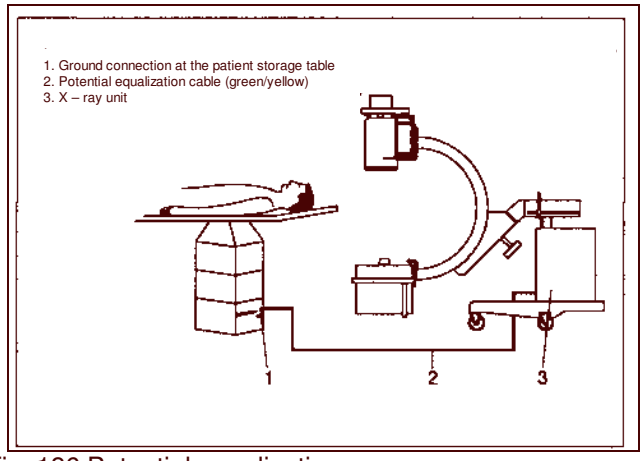


Fig. 186 Potential equalization

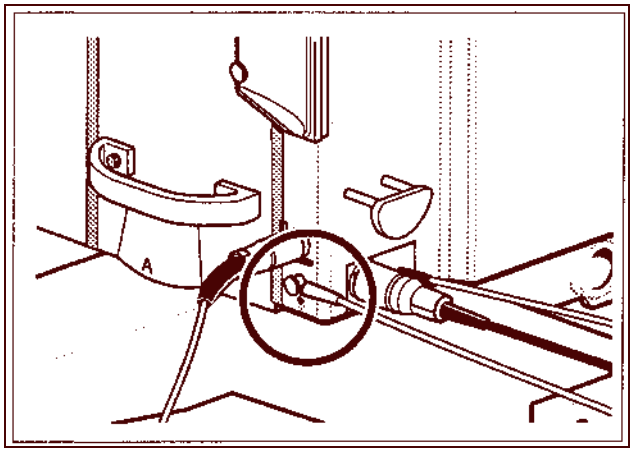


Fig. 187 Connection point potential equalization

2.16.8 Radiation protection area

The necessary radiation protection areas are partition in two categories

- Operational monitored area
- Controlled area

2.16.8.1 Operational monitored area

An operational monitored area are the range, within which persons in the calendar year can receive higher body doses from complete body expositions than 5 mSv, but no controlled area is.

Operational monitored areas are to be specified.

2.16.8.2 Controlled area

A controlled area is the range, within which persons in the calendar year can receive higher body doses from complete body expositions than 15 mSv.

Controlled areas are to be defined. They must be characterized during switch-on time. The marking does have clearly visibly at least the words "No admission – X - ray" contain; it must be present also during ready state.

All persons for other reasons than to their medical or dental investigation or treatment in the controlled area are have an official personal dosimeter to carry.

CAUTION

A sufficient protective clothing and a personal dosimeter have to carry all persons in the controlled area, as far as by a permanent institution a sufficient protection is not ensured; this does not apply to those which can be examined or to treating persons.

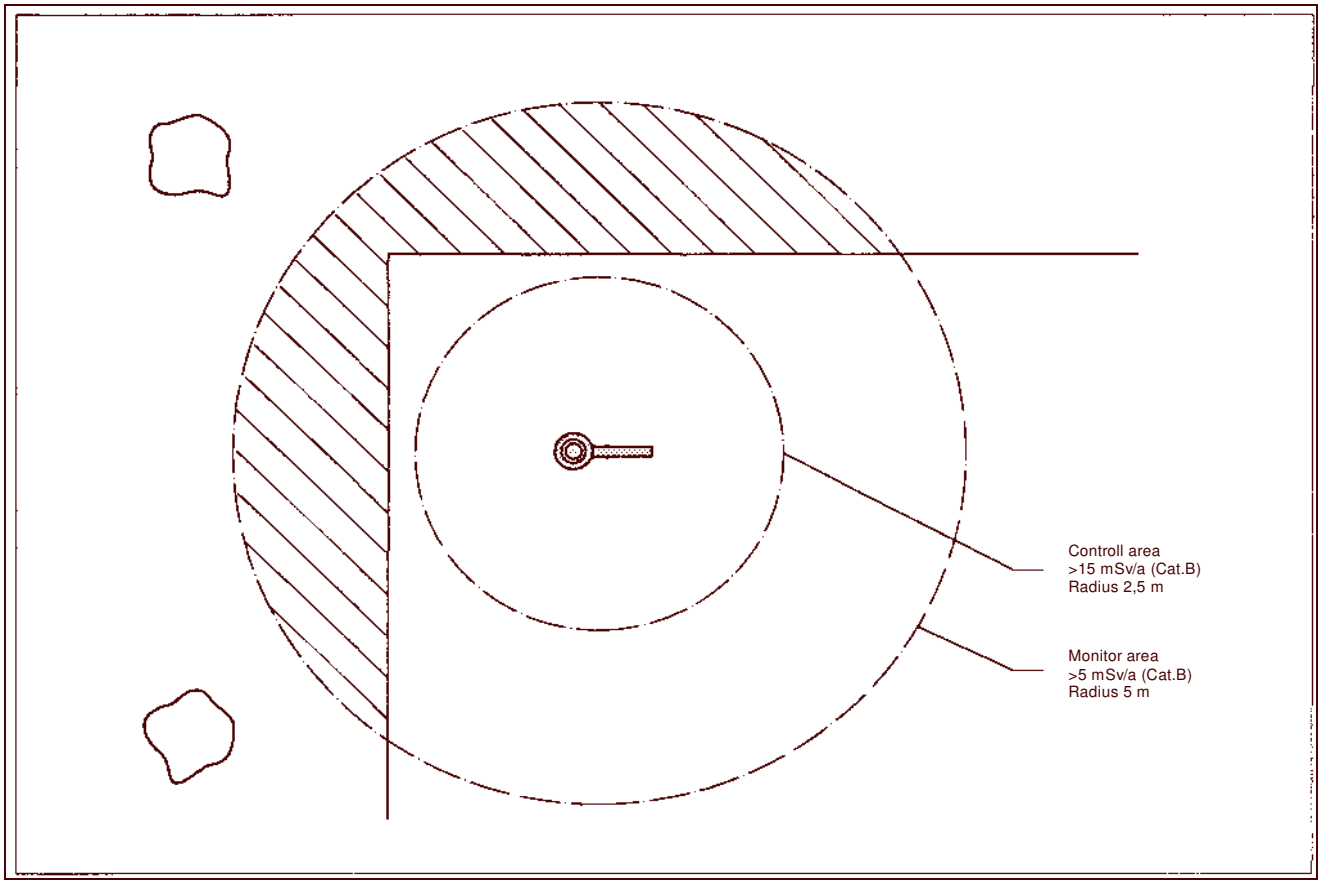


Fig. 188 Control and monitored area in not shielding environment from top

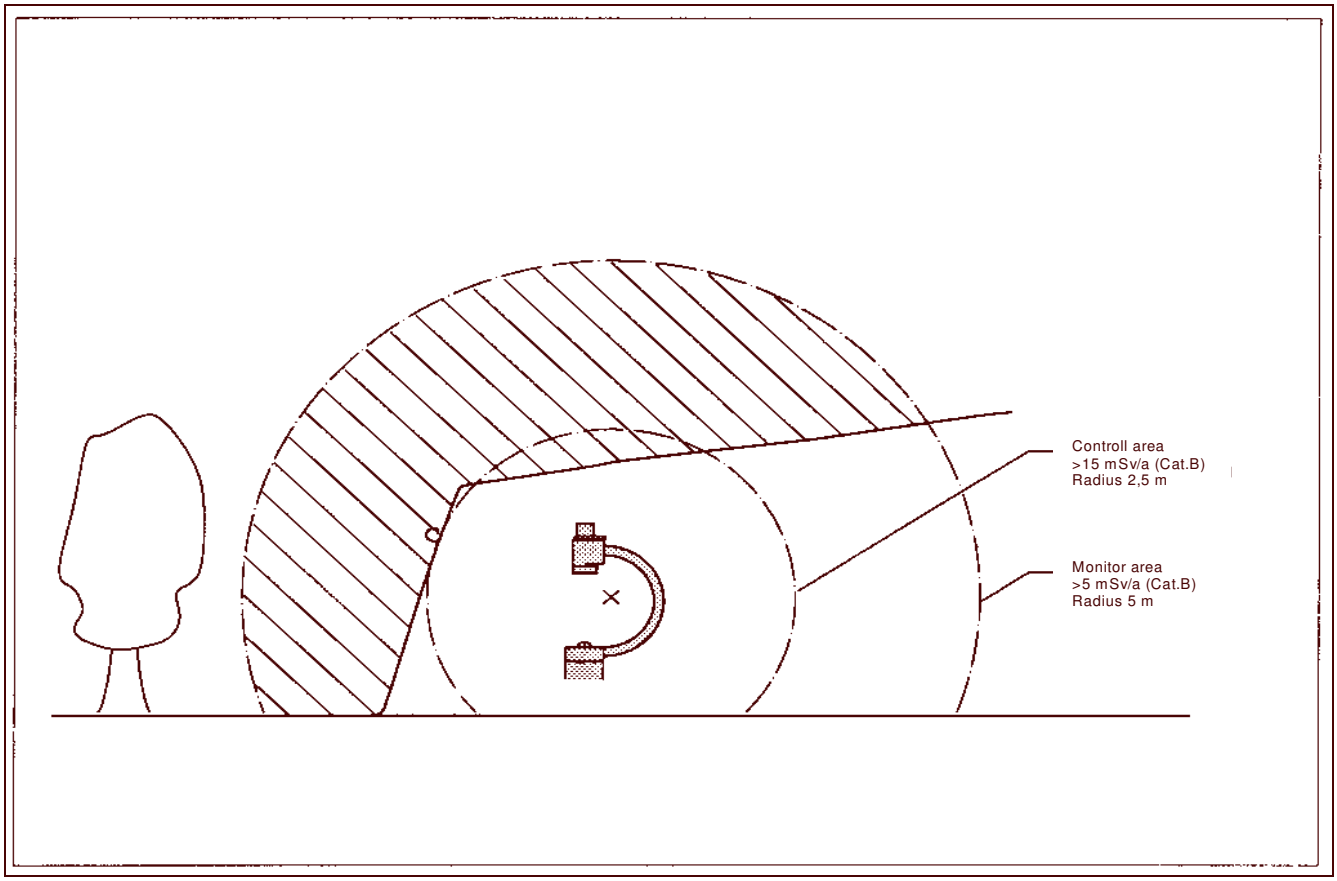


Fig. 189 Control and monitored area in not shielding environment from the side

The marking of the individual ranges has to take place with the employment of the installation in not shielding environment particularly remarkably and clearly.

CAUTION The marking of the controlled area must be present also outside of the work area true ready status and switch-on time.

2.16.8.3 Vocational persons exposed to radiation

Persons, who can receive more than one tenth of the limit values during their practise of the profession or during their professional training according to table 1 column 2.

Are differentiated:

- Persons vocationally exposed to radiation of the category A:
- Persons, the more than three tenths of the limit values according to table 1 column 2 received know.

- Persons vocationally exposed to radiation of the category B:
- Persons, who can receive more than one tenth at most up to three tenths of the limit values according to table 1 column 2.

The protection of persons vocationally exposed to radiation from x - rays is to be guaranteed in all places, in which it permits the operational sequence, by permanent institutions, in particular by shielding or spacer attitude. Permanent institutions must be so laid out with consideration of the residence time that the body doses received from a person during the normal operational sequence cannot exceed a fifth of the values of the table 1 column 2.

2.16.8.4 Tables for the calculation of the body doses

Table 1 Limit values for annual body dose [1)]

Body dose	persons vocationally exposed to radiation in the calendar year of the category A	B
1	2	3
Effective dose	50 mSv	15mSv
1. Partial body dose: Gonads, uterus, red marrow	50 mSv	15 mSv
2. Partial body dose: All organs and fabrics, so far not under 1., 3., 4. mentioned	150 mSv	45 mSv
3. Partial body dose: Thyroid, bone surface, skin, so far not under 4.mentioned	300 mSv	90 mSv
4. Partial body dose: Hands, lower arms, feet, shank, ankle, incl. the pertinent skin	500 mSv	150 mSv

Table 2 Priority factors

Organs and fabric	Priority factors
1	2
Gonads	0,25
Thorax	0,15
red marrow	0,12
Lung	0,12
Thyroid	0,03
Bone surface	0,03
other organs and fabric:[2)] blister, upper large intestine, lower large intestine, small intestine, brain, liver, stomach, spleen, suprarenal body, kidney, pancreas, thymus, uterus	ever 0,06

1) For the computation of the effective dose with a whole or a subfield exposition the equivalent doses of the organs and fabrics with the priority factors of the table 2, specified in table 1, are multiplied and the in such a way received products are added.

2) To determination of the contribution of the other organs and fabrics with the computation of the effective dose the partial body dose for everyone of the five other organs or fabrics most strongly exposed to radiation is to be determined. The radiation exposure of all remaining organs and fabrics remains unconsidered with the computation of the effective dose.

2.17 Constant check

In accordance with the X - ray regulation of a Constant check is prescribed for 1.1.88 in accordance with § 16 and must be accomplished with all X-ray units in use at least monthly.

The Constant checks are to be accomplished by the operator of the X – ray system at least monthly or arranged.

REFERENCE The results of the constant check must be documented (X - ray unit book).

The documentation of the constant check and photographs of the inspection piece must be submitted by the operator upon the requests of the competent authority!

During excess of the ranges of tolerance the equipment up to the removal of the faulty is to be quiet-added.

The execution of the constant check is not described in this regulation. It is referred to the DIN 6813 part 3. and 4.

Part 3 Troubleshooting

3.1 Error listing with trouble shooting hints

Fault / Trouble	Reason	Repairing
X - ray unit cannot be switched on No "Error" message WA1: LED H1 off	Electronics block (mains voltage) faulty	PCB WA1 replace if error remains PCB MPC to change if error remains look for more information at the schematics
X - ray unit cannot be switched on. No "Error" message WA1: LED H1 on	Electronics block (monitoring loop, connections) faulty!	PCB WA2 replace if error remains PCB WA1 change if error remains PCB SB1 und SB2 change if error remains look for more information at the schematics
Mains display flashes	Electronics block (mains controller) faulty	PCB WA1 replace, if error remains PCB WA2 change if error remains look for more information at the schematics
Mains display flashes and "Error" - 1 flashes	Electronics block (image intensifier HV) faulty	SE15: LED H1 in the electronics block check if SE15: LED H1 off PCB SE13 and SE15 change if SE15: LED H1 on PCB SE15 change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Mains display flashes and "Error" – 2, 3, or 5 flashes	Electronics block (X – ray generator) faulty	SE15: LED H3 and LED H4 check if both LED´s off PCB SE13 and SE15 change if SE15: LED H3 or LED H4 on PCB SE15 change if error remains look for more information at the schematics
Mains display flashes and "Error" – 6, 7, or 8 flashes	Electronics block (clocking) faulty!	SE15: LED H4 and WA1: LED H2 check if SE15: LED H4 and or WA1: LED H2 off PCB SE13 and SE15 change if SE15: LED H4 on PCB WA1 and WA2 change if SE15: LED H4 on PCB SE13 and SE15 change if error remains PCB SE17 change if error remains look for more information at the schematics
No indicating of the selected mode of operation	Electronics block (fluoroscopy selection) faulty	PCB SB1 and SB2 change if error remains PCB SE13 and SE15 change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
No indicating of the selected mode of operation “Aufnahme”(it means “radiography”)	Electronics block (radiography selecting) faulty	PCBs SB1 and SB2 change if error remains PCB SE13 and SE15 change if error remains look for more information at the schematics
Mode of operation “Durchleuchten” (it means fluoroscopy) indicated however kV display or mA-indicate or min-indicate darkly or un clearly	Electronics block (indicator control) faulty	PCB SE13 and SE15 change if error remains PCB SB2 change if error remains look for more information at the schematics
Display unit mains control (lamp in the switch) darkly and screen without indications of memory picture (two bars)	Bit map memory unit faulty	PCB WT1 in the bit map memory unit change if error remains PCB WHD25 in the bit map memory unit change if error remains PCB WHD15 in the bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Display unit mains control (lamp in the switch) darkly and screen without indications of memory picture (two bars)	Display unit faulty	Fuse F1 in the display unit check if error remains PCB WM20 in the display unit change if error remains look for more information at the schematics
Display unit mains control (lamp in the switch) darkly and screen without indications of memory picture (two bars)	Electronics block faulty	PCB SA1 in the electronics block change if error remains look for more information at the schematics
Display unit mains control (lamp in the switch) shines and for screen without indications of memory picture (two bars)	Bit map memory unit faulty	Unit WSU in the bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains PCB WHD25 and WHD15 in the bit map memory unit change if error remains look for more information at the schematics
Display unit mains control (lamp in the switch) shines and for screen without indications of memory picture (two bars)	Display unit faulty Electronics block faulty	look for more information at the schematics look for more information at the schematics
Track display incorrectly (wrong)	Bit map memory unit faulty	Floppy disk drive assembly change if error remains PCB WHD25 in the bit map memory unit change if error remains PCBs SB1 and SB2 in the bit map memory unit change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
LED memory selection at the bit map memory unit off	Bit map memory unit faulty	PCB WB1 in the bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains look for more information at the schematics
LED memory selection at the bit map memory unit off	Electronics block faulty	look for more information at the schematics
LED brightness/contrast automatic at the bit map memory unit always off	Display unit faulty	PCB WM60 in the display unit change if error remains if error remains look for more information at the schematics
LED brightness/contrast automatic at the bit map memory unit always off	Bit map memory unit faulty	PCB WB1 in the Bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains look for more information at the schematics
Radiation indication to remains off, but no "error" message appears	Hand or double foot switch faulty Electronics block faulty	Switch check and or change PCBs SE13 and SE17 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off, and "Error" -1 message appears	Electronics block faulty	PCB SE37 in the electronics block change if error remains PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Radiation indication to remains off and "Error" 1 message	Electronics block faulty	look for more information at the schematics
Radiation indication to remains off and "Error" -2 message appears	Electronics block faulty	PCB WN19 in the electronics block change if error remains PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off and "Error" 3 or 9 message appears	Electronics block faulty	PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off and "Error" 4 message appears	Bit map memory unit faulty	PCB WHD23 in the bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains look for more information at the schematics
Radiation indication to remains off and "Error" 5, 6, 7 or 8 message appears	Electronics block faulty	PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off, mains display flashes, but no "Error" message appears	Electronics block (mains power control) faulty	PCB WA1 and WA2 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Radiation indication to remains off, mains display flashes, and "Error" 2 or 3 message flashes	Electronics block (X - ray generator) faulty	PCB SE37 in the electronics block change if error remains PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off, mains display flashes, and "Error" 4, 6, 7 or 8 message flashes	Electronics block faulty	PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Radiation indication to remains off, mains display flashes, "Error" -5 message flashes and the temperature indication flashes	Electronics block (message X – ray source temperature) faulty	PCBs SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
kV and mA display runs (independently of radiation release) up to 105 kV/3,1 mA. (bit map memories attached)	Bit map memory unit faulty Electronics block faulty	PCB WHA in the bit map memory unit change if error remains look for more information at the schematics PCB SE13 in the electronics block change if error remains look for more information at the schematics
No fluoroscopy picture on the screen present	Electronics block faulty	PCB WN of 19 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
No fluoroscopy picture on the screen present	Bit map memory unit faulty	PCB WHD15 and WHD17 in the bit map memory unit change if error remains PCB WHA in the bit map memory unit change if error remains look for more information at the schematics
kV or mA doesn't have a stable display	Electronics block faulty	PCB SE19 in the electronics block change if error remains look for more information at the schematics
Fluoroscopy picture incorrectly	Bit map memory unit faulty Electronics block faulty	PCB WHD13 and WHD23 in the bit map memory unit change if error remains look for more information at the schematics PCB SE17 in the electronics block change if error remains PCB WN19 in the electronics block change if error remains look for more information at the schematics
Fluoroscopy timer doesn't counts	Electronics block (clock) faulty	PCB SE13 and SE15 in the electronics block change if error remains look for more information at the schematics
Picture insertion incorrectly	Electronics block (aperture control) faulty	PCB SE23 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Picture inversion not possible	Electronics block faulty	PCB SE13 and SE17 in the electronics block change if error remains look for more information at the schematics
Last fluoroscopy picture stored not on the screen	Electronics block faulty Bit map memory unit faulty	PCB SE13 and SE17 in the electronics block change if error remains look for more information at the schematics PCB WHA in the bit map memory unit change if error remains PCB WHD23 in the bit map memory unit change if error remains look for more information at the schematics
On pulsed fluoroscopy mode no change between fluoroscopy- and memory picture	Electronics block faulty Bit map memory unit faulty	PCB SE13 and SE17 in the electronics block change if error remains look for more information at the schematics PCBs WHA and WHD23 in the bit map memory unit change if error remains look for more information at the schematics
After a snapshot no stored picture on the screen present	Bit map memory unit faulty	PCBs WHA and WHD23 in the bit map memory unit change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
After a snapshot no stored picture on the screen present	Electronics block faulty	PCB SE13 and SE17 in the electronics block change if error remains look for more information at the schematics
Radiation indication remains after releasing hand or foot switch	Electronics block faulty	PCB SE13 and SE17 in the electronics block change if error remains look for more information at the schematics
	Bit map memory unit faulty	PCBs WHA and WHD23 in the bit map memory change if error remains look for more information at the schematics
Picture rotation not possible	Electronics block faulty	PCB WA1 and SE13 in the electronics block change if error remains look for more information at the schematics
	Display unit faulty	PCB WM60 in the display unit change if error remains look for more information at the schematics
Screen window insertion on the screen not possible	Bit map memory unit faulty	PCBs WHA and WB1 in the bit map memory change if error remains look for more information at the schematics
Picture on the screen is strong grainy	Bit map memory unit faulty	PCBs WHA and WHD13 in the bit map memory change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Automatic brightness contrast regulation doesn't works correctly	Electronics block faulty	PCB SE13 in the electronics block change if error remains look for more information at the schematics
	Bit map memory unit faulty	PCB WHA in the bit map memory unit change if error remains
	Display unit faulty	look for more information at the schematics
No picture change after realized memory change	Bit map memory unit faulty	PCBs WHA and WHD23 in the bit map memory change if error remains look for more information at the schematics
No format control after inserting a floppy disk or format control wrongly	Bit map memory unit faulty	PCB WHD21 in the bit map memory unit change if error remains look for more information at the schematics
Floppy disk can't formatting	Bit map memory unit faulty	PCBs WHD21 and WHD23 in the bit map memory unit change if error remains look for more information at the schematics
Track counter counts not track +1	Bit map memory unit faulty	PCBs WHD 21 and WHD23 in the bit map memory change if error remains look for more information at the schematics
Picture doesn't store on floppy disk	Electronics block faulty	PCB SE13 in the electronics block change if error remains
	Bit map memory unit faulty	PCBs WHA in the bit map memory change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
	Bit map memory unit faulty	PCB WHD23 in the bit map memory unit change if error remains look for more information at the schematics
LED "disk" doesn't shines	Electronics block (control panel) faulty	PCBs SB1 and SB2 in the electronics block change if error remains look for more information at the schematics
Track display incorrect	Bit map memory unit faulty	PCB WB1 in the bit map memory unit change if error remains look for more information at the schematics
Track display when reading from floppy disk incorrect	Bit map memory unit faulty	PCB WHD23 in the bit map memory unit change if error remains look for more information at the schematics
Track on the floppy disk is not readable or floppy diskette picture on the screen badly represented	Bit map memory unit faulty	Floppy disk drive assembly replace if error remains PCB WHD21 in the bit map memory unit change if error remains look for more information at the schematics
Radiography mode can not be selected (LED out)	Electronics block (radiography mode selecting) faulty	PCB SB1 and SB2 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
kV and mAs - display darkly or # 78kV, # 20 mAs	Electronics block faulty	PCB SE13 and SB2 in the electronics block change if error remains look for more information at the schematics
APR LED off	Electronics block faulty	PCB SB1 and SB2 in the electronics block change if error remains look for more information at the schematics
After the exposure remains the radiation indication however no acoustic signal sounded	Electronics block (radiography control) faulty	PCB SE13 and SE17 in the electronics block change if error remains PCB SB2 in electronics block change if error remains look for more information at the schematics
Indication of the selected kind of radiography wrong	Electronics block (radiography control) faulty	PCB SB1 and SB2 in the electronics block change if error remains look for more information at the schematics
Automatikanzeige bleibt bei Aufnahme mit Handeinstellung	Electronics block (radiography control) faulty	PCB SB1 and SB2 in the electronics block change if error remains look for more information at the schematics
Werte für kV und mAs lassen sich nicht verstellen	Electronics block (radiography control) faulty	PCB SB1 and SB2 in the electronics block change if error remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
Inserted film not exposed (no density)	Electronics block faulty	PCB SE13 and SE17 in the electronics block change if errors remains PCB SB1 and SB2 in the electronics block change if errors remains look for more information at the schematics
Radiography operation with collimator not possible	Electronics block faulty	PCB SE13 in the electronics block change if error remains look for more information at the schematics
Radiography operation with collimator on table or cartridge stand not possible	Electronics block faulty	PCB SE13 in the electronics block change if errors remains look for more information at the schematics
In the radiography operation with collimator kV and mAs display darkly or # 78kV, # 20 mAs	Electronics block faulty	PCB SB1 and SB2 in the electronics block change if errors remains PCB SE13 in the electronics block change if errors remains look for more information at the schematics
Fluoroscopy operation with installed collimator possible	Electronics block faulty	PCB SE13 in the electronics block change if errors remains look for more information at the schematics
Dental radiography mode not possible	Electronics block faulty	PCB SE13 and SE17 in the electronics block change if errors remains look for more information at the schematics

Fault / Trouble	Reason	Repairing
The kV and mAs value is with Dental exposure not preset to 60 kV and 0.2 mAs	Electronics block faulty	PCB SE13 and SB2 in the electronics block change if errors remains look for more information at the schematics
Fluoroscopy operation with installed dental tubus possible	Electronics block faulty	PCB SB1 and SB2 in the electronics block change if errors remains look for more information at the schematics

3.2 General repair procedure

3.2.1.1 Behaviour with assembly works

The tool what you needed for removement or replacement is to be laid out before beginning of work.

(1) Separated plugs or cable connectors with protective caps perform.
(2) Protective caps only directly remove before attaching the plug or cable connectors.
(3) Before the installation check all connections for perfect condition and cleanliness.
(4) With bolt connections consider the general torque data.
(5) With assembly works only new seals, split pins, safety device sheet metals, securing wires and lock washers use.

3.2.1.2 Ground connections

CAUTION Technical security -, operational safety -, environmental and radiation protection regulations consider.

REFERENCE Ground connections can be electrically leading contact points between assembled individual parts or separate earth cables.

(1) Contact areas clean and make metallically bright.
(2) The appropriate parts/units in such a way in installation position bring that the electrical conductivity between the parts or units is ensured.
(3) The necessary junction parts(screws, rivets) attach.

3.2.2 Cables, connector and equipment plug sockets checking and cleaning

CAUTION Technical security -, operational safety -, environmental and radiation protection regulations consider.

Connectors and equipment plug sockets cleaning

(1) Penetrated foreign bodies remove.
(2) Penetrated humidity remove by blowing out or drying up.
(3) In the case of contamination due to oil or fat connector or equipment plug sockets with cleaning agent cleaning and drying up.
(4) Seal inserts of the protective caps clean and easily rub in with talcum powder.
(5) Cleaned connectors and equipment plug sockets with the pertinent protective caps lock.

Cable on damaging check.

REFERENCE Connections must be separated, cables can be remain in the mounting plate.

(1) Cable sheath for tears and bends check.
(2) Cable clamp with cables permanently installed for tightness check.
(3) Plugs for oxidation and bent contacts check.
(4) Plugs if necessary repair.

3.2.3 Corrosion removing/coat of paint

CAUTION Technical security -, operational safety -, environmental and radiation protection regulations consider.

Corrosion removing on not painted surfaces

Smaller one, corroded surfaces as follows work on:

(1) The appropriate places so for a long time with sandpaper grind off, until the corrosion is eliminated.
(2) The treated places with grease treat.

Corrosion removing on painted surfaces

(1) During oil and fat contamination appropriate range with cleaning agent pre cleaning.
(2) Strong corrosion with a wire brush or a scraper remove.

CAUTION When removing the corrosion with a machine must be carried an eye protector. Painting or lacquers containing zinc chromate may not by drying jets or sharpens to be removed (formation of carcinogenic dust).

(3) The corrosion places and adjacent ranges so for a long time grinding off (wet) with sand paper, until the corrosion is eliminated.
(4) Treated ranges with coat of paint provide.

Coat of paint repair

Smaller one, defective, painted surfaces as follows work on:

(1) Corrosion remove.

CAUTION Painting or lacquers containing zinc chromate may not by drying jets or sharpen to be removed (formation of carcinogenic dust).

(2) Old parts of color remainders with sand paper wet grind off.
(3) The treated place with solvent to clean and ventilate leave.

ATTENTION The solvent to for a long time to influence do not leave, since it dissolves the existing coat of paint!

REFERENCE Solvent do not contaminate; give therefore solvents on a cloth.

(4) On the cleaned place adhesive primer apply and leave drying.
(5) Primers apply and leave drying.

REFERENCE Drying time after manufacturer data keep.

(6) The primer with sand paper wet grind off , so that a good transition develops and let dry.
(7) Treated surfaces with solvent to clean and ventilate leave.
(8) Finish coating to apply on and dry leave.

3.2.4 Chassis

3.2.4.1 Wheel and mounting plate changes

1. Slot headed screws (190/3) unscrews, wheel (190/2) removes.
2. Axle with internal thread take.
3. Unscrew hexagonal screw (190/1)and with toothed washer and disk lay down.
4. Holder (190/4) remove.
5. Removed small articles controlling for re usable.
6. New wheel with holder install.
7. Hexagonal screw with toothed washer and disk insert and tighten.

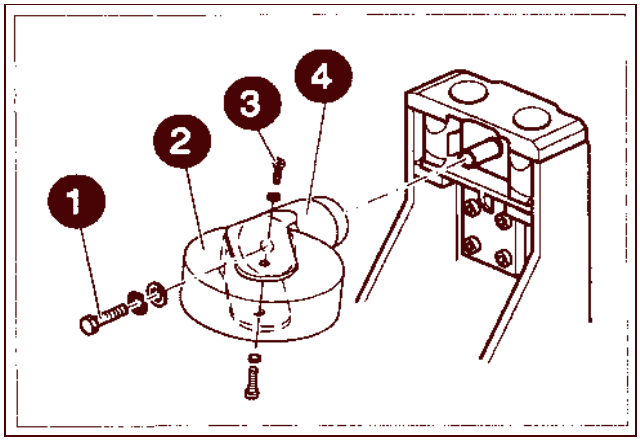


Fig. 190

3.2.4.2 Guide plate changes

1. Two screws (191/1) unscrews and lay down.
2. Guide plate (191/2) remove.
3. Removed small articles controlling for re usable.
4. New guide plate install. Both screws with Loctite secure.

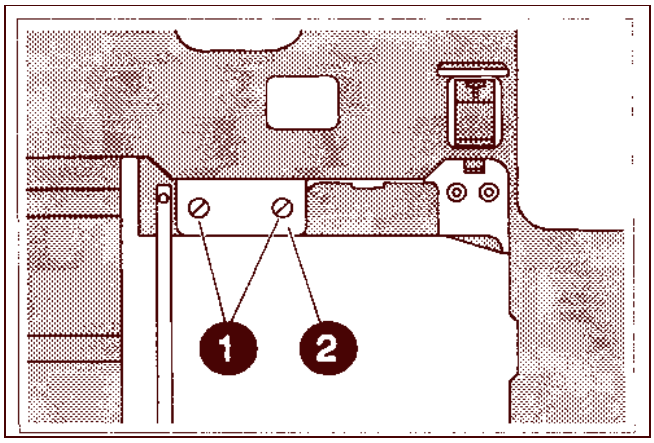


Fig. 191

3.2.4.3 Guidance wave changes

1. Two screws (192/1) unscrews and with the pertinent disks and lock washers lay down.
2. Guidance wave (192/2) remove.
3. Removed small articles controlling for re usable.

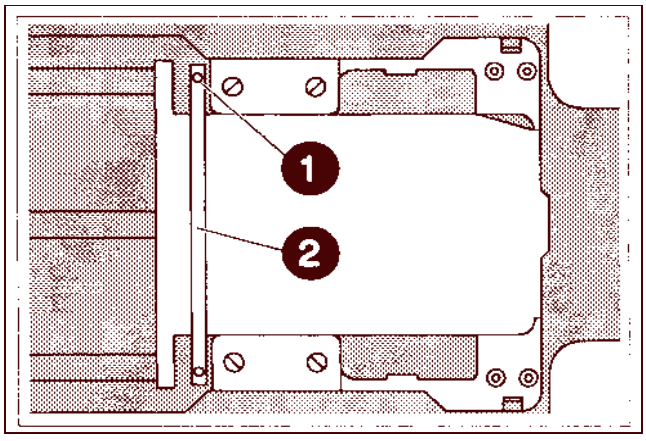


Fig. 192

3.2.4.4 Kick strip plate changes

The kick strip plate serves for interception of impacts during the brake operation.

1. Six screws (193/2) unscrew and with the pertinent washers lay down.
2. Kick strip plate (193/1) remove.
3. Removed small articles controlling for re usable.
4. New kick strip plate install.

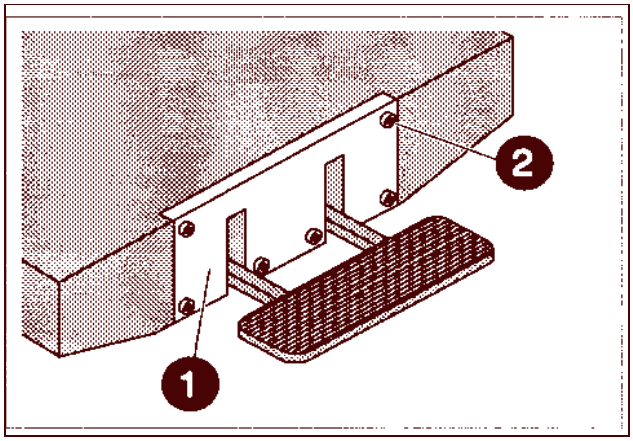


Fig. 193

3.2.4.5 Rubber plating of the brake pedal changes

The rubber plating may not be seal up together.

1. Old rubber plating (194/1) take off carefully with a screwdriver.
2. The metal surface of the brake pedal cleaning.
3. New rubber plating install. At low temperatures is the rubber plating before the assembly to warm up (fan, water bath).

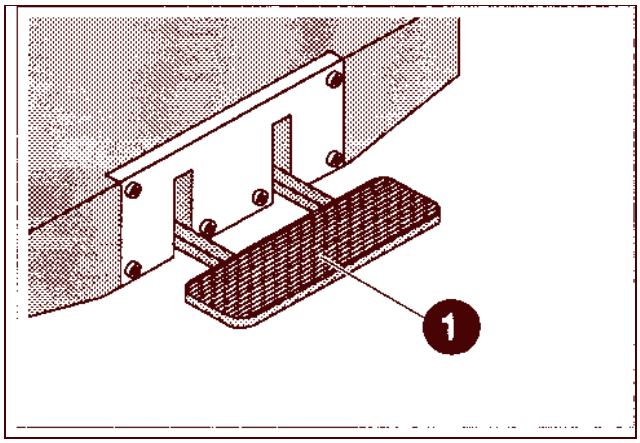


Fig. 194

3.2.4.6 Tension spring/wire rope

The wire rope may not be rotated when assembling.

1. Tension spring (195/2) carefully at the brake lever put out and separate from the wire rope (195/3).
2. From the top side of the chassis take the cylindrical pin (195/4) from the wire eye.
3. The metal surface of the reel (195/1) cleaning.
4. New tension spring/wire rope install. Put in first the cylindrical pin on the top side.

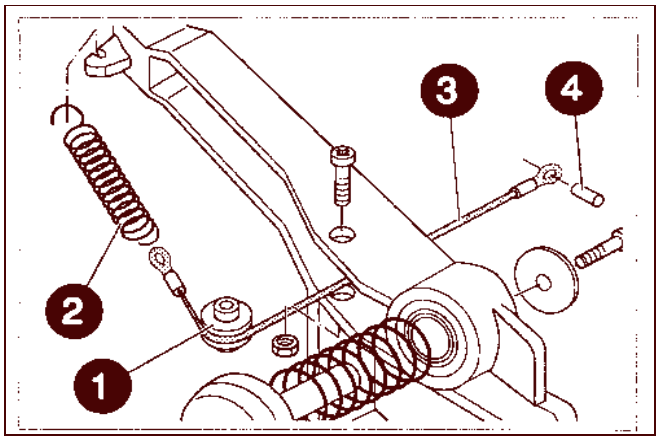


Fig. 195

3.2.4.7 Barrier for stroke column changes

1. Tension spring on the lower surface of the chassis put out.
2. At the top side of the chassis both screws (196/2) unscrew and the barrier (196/1) remove.
3. Removed small articles controlling for re usable.
4. New barrier install. Both screw with loctite secure.
5. Tension spring on the lower surface hang up.

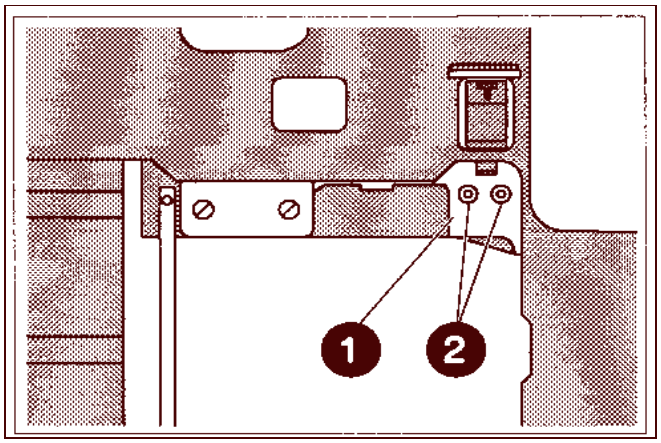


Fig. 196

3.2.4.8 Absorption buffers at the brake lever change

Brake determine and with suitable article block.

1. Hexagon nut (197/1) unscrew and the lock washer (197/2) and the disk (197/3) remove.
2. Absorption buffer (197/4) remove.
3. Removed small articles controlling for re usable.
4. New absorption buffer install.

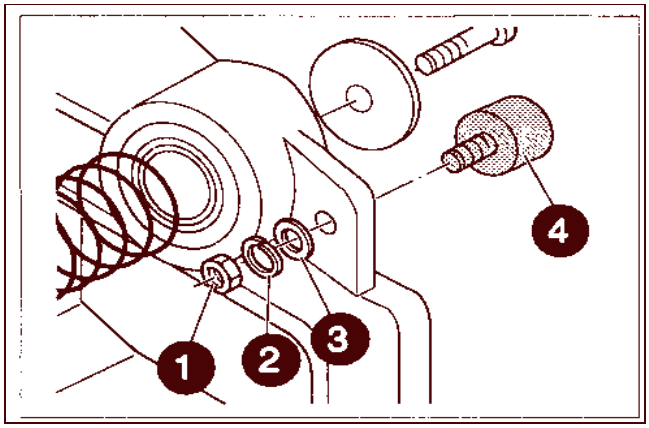


Fig. 197

3.2.4.9 Unblocking mechanism changes

1. Brake loosing and both wires rope with cylinder pin hang up.
2. At the top side of the chassis two screws unscrew (198/1) and the both unblocking mechanisms remove
3. Removed small articles controlling for re usable.
4. Unblocking mechanism repair or replace and install.
5. Both wires rope with cylindrical pin hang up.

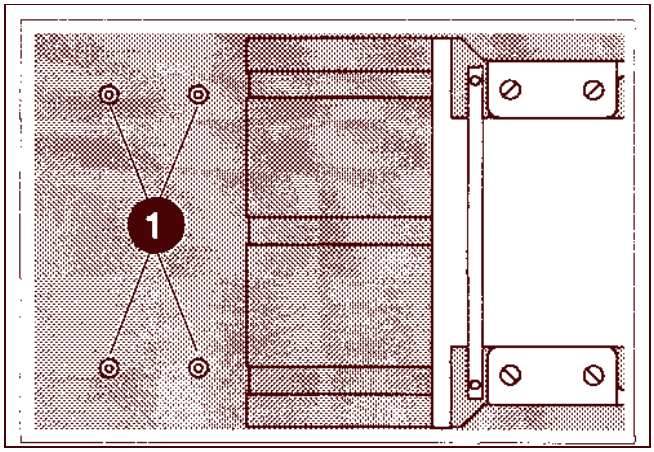


Fig. 198

3.2.4.10 Brake buffers change

1. Brake solve and both wires rope with cylindrical pin hang up.
2. Unscrew at the top side of the chassis two screws and the unblocking mechanisms remove.
3. Brake levers hinge away.
4. In each case two socket head screws unscrew and the hinge pins as well as the disk and the lock washer lay down

CAUTION With the replacement of the brake buffers is to be considered the large spring tension.

5. Brake levers with the brake buffers (199/1) **downward** put on the soil.
6. The brake lever with the knee press to the soil, the socket head screw (199/4) unscrew and together with the disk (199/3) lay down.
7. The knee slowly raise and thus the spring (199/2) relieve.
8. Removed small articles controlling for re usable.
9. New brake buffer or spring install.
10. Both hinge pins put in and the brake lever centred in the cut outs with the foot.
11. Unblocking mechanisms install.
12. Brake levers fold and the wire ropes and the springs hang up.

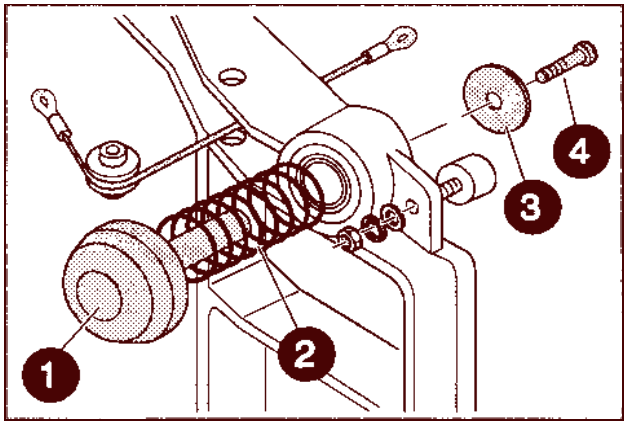


Fig. 199

3.2.5 Stroke column

3.2.5.1 Guard plate of the drive belts changes

1. The six socket head screws (200/2) unscrews and with the disk and the lock washer lay down.
2. Guard plate (200/1) remove.
3. Removed small articles controlling for re usable.
4. New or repaired guard plate into reversed sequence install.

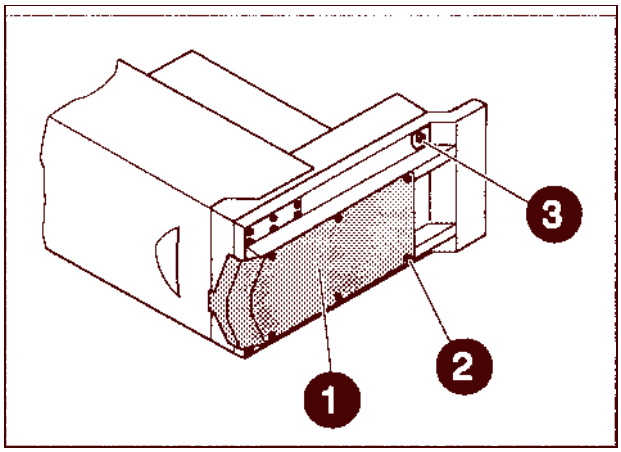


Fig. 200

3.2.5.2 Protective hood for motor completly changes

1. Terminal block after loosening the bolts (200/3 and 201/1) remove.
2. The six socket head screws (201/2) unscrew and with the disk and the lock washer lay down.

REFERENCE The middle screws do not loose.

3. Protection hood (201/3) remove.
4. Removed small articles controlling for re usable.
5. The assembly of the new or repaired protection hood takes install in reverse sequence.
   The bolts of the connection block must be secured with loctite

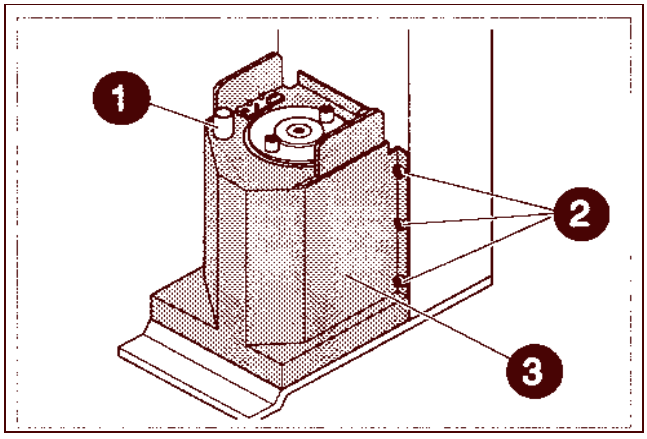


Fig. 201

3.2.5.3 Engine hand wheel completely or only knob changes

1. The screw (202/1) in the center of the hand wheel unscrews and together with the disk lay down.
2. The complete hand wheel (202/3) upward strip off.
3. The fitted screw (202/2) of the knobs (202/4) unscrew and the knob replace.
4. Removed small articles controlling for re usable.
5. The hand wheel or the rotary knob with the screws again fasten and with loctite secure.

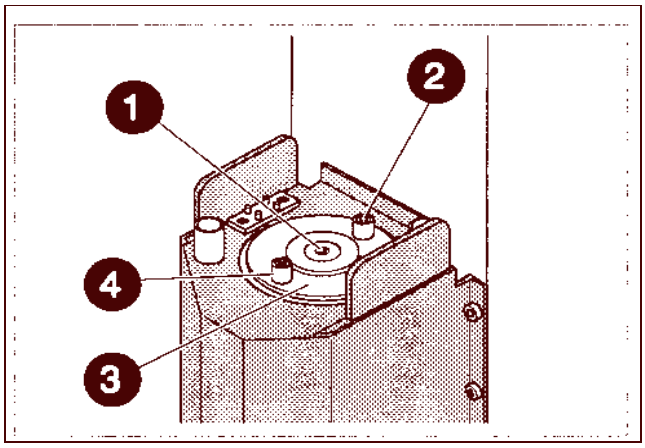


Fig. 202

3.2.5.4 Covers of the stroke column change

A) Cover over the engine

1. The four screws (203/3) and the four socket head screws (203/2) screw out and together with the lock washer and the washer lay down..
2. Cover (203/1) remove
3. New or repaired cover install in reverse sequence and the screws secure with loctite.

B) Cover behind the engine

1. Protective hood for motor dismantle
2. The two socket head screws (204/1)unscrew and together with the lock washers lay down.
3. Cover (204/2) upward pull out
4. New or repaired cover in reversed sequence install.

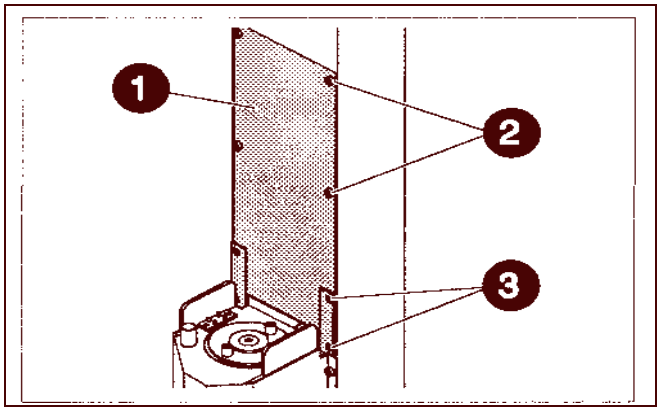


Fig. 203

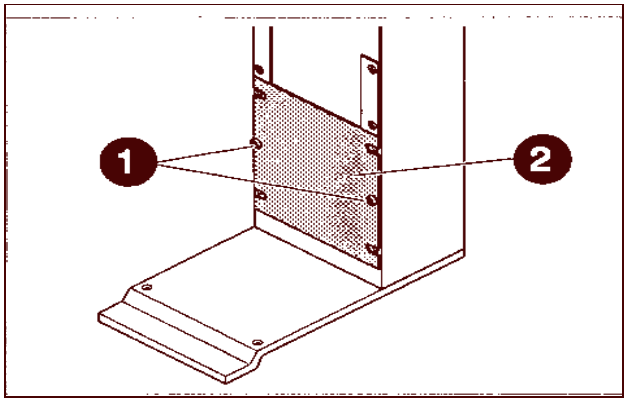


Fig. 205

3.2.5.5 Handle changes

1. Two hexagon bolts (206/1) unscrew and together with the lock washers lay down.
2. Handle (206/2) remove.
3. Removed small articles controlling for re usable.
4. New or repaired handle into reversed sequence install.

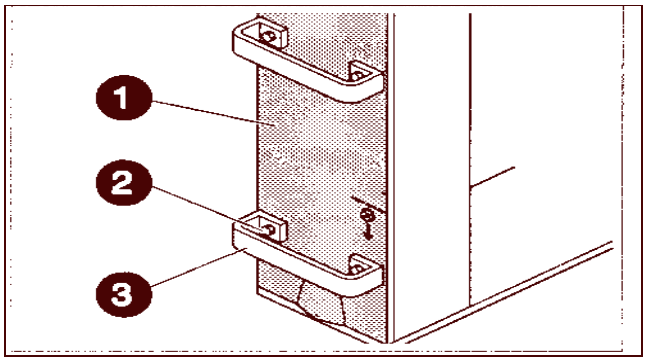
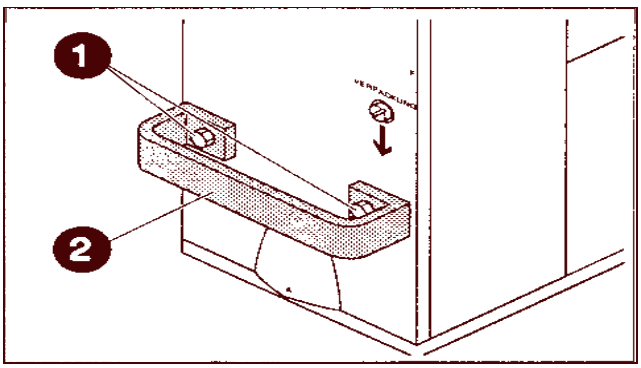


Fig. 206



3.2.5.6 Drive belt change

Reference Representations see to Appendix B

1. The stroke column on a table placing and laterally for laying down
2. The six socket head screws unscrew and with disk and lock washer lay down..
3. Guard plate remove.
4. Installation position of the plug for re-installation mark.
5. Two screws loosen and the plug from the motor protective cover remove.
6. Six socket head screws unscrew and the motor protective cover remove.
7. The nut of the clamping spring adjustment loosen.
8. The three screws of the motor attachment somewhat loosen.
9. Drive belt replace.
10. The nut of the clamping spring up to the stop of the range of adjustment tighten.
11. The three screws of the motor attachment tighten.
12. Taken small articles for reusability check.
13. Protective cover for motor, plug and guard plate install.

3.2.5.7 V-belt tension adjustment

Reference Representations see to Appendix B

1. The stroke column on a table placing and laterally for laying down
1. The six socket head screws unscrew and with disk and lock washer lay down.
2. Guard plate remove.
3. Installation position of the plug for re-installation mark.
4. Two screws loosen and the plug from the motor protective cover remove.
5. Six socket head screws unscrew and the motor protective cover remove.
6. The nut of the clamping spring adjustment loosen.
7. The three screws of the motor attachment somewhat loosen.
8. The nut of the clamping spring up to the stop of the range of adjustment tighten.
9. The three screws of the motor attachment tighten.
10. Taken small articles for reusability check.
11. Protective cover for motor, plug and guard plate install.

3.2.6 Electronics block

3.2.6.1 Cover changes

A) Front cover

1. Front cover (207/1) after loosening of the screws (207/2) remove.
2. New or repaired cover attach again

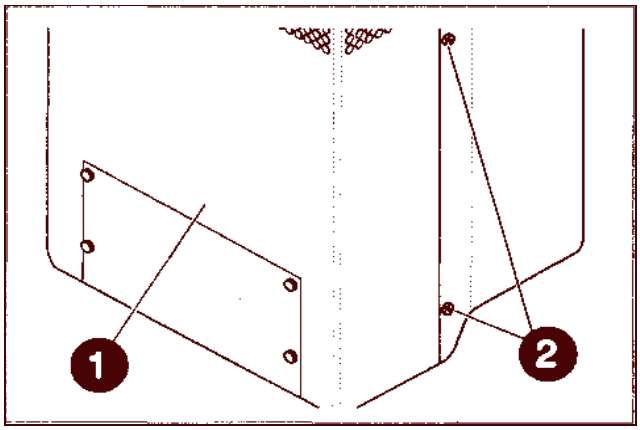


Fig. 207

B) Side covers

REFERENCE
The type of mounting of both side cover are identical.

1. Right side cover (208/2) after loosening of the screws (208/1 and 208/3) remove.
2. New or repaired cover attach again.

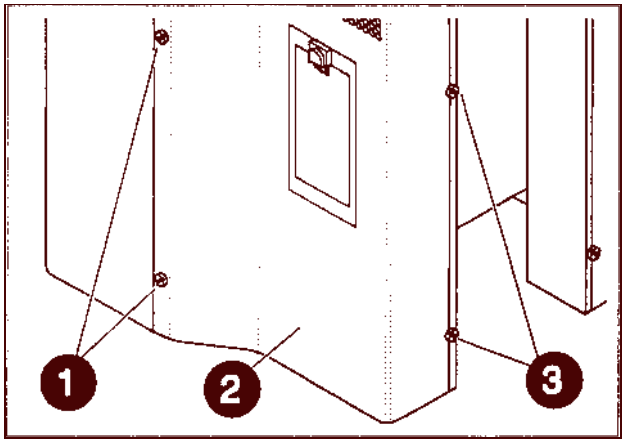


Fig. 208

3.2.6.2 Kick strip plate change

1. Kick strip plate (209/2) after loosening of the screws (209/1) remove.
2. New or repaired plate attach and the screws with loctite secure.

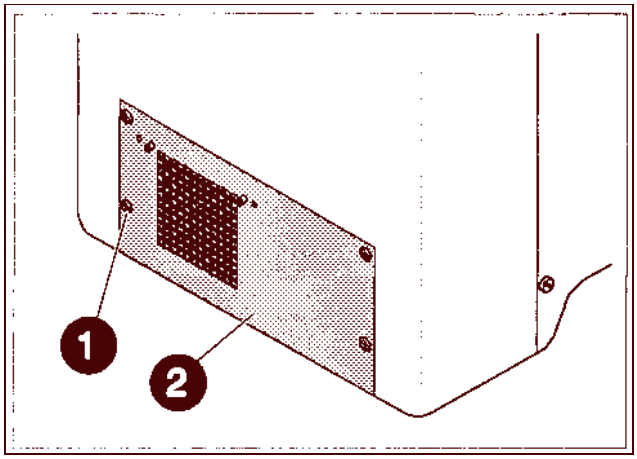


Fig. 209

3.2.6.3 Bolting device of the collimator changes

1. Rights side cover remove.
2. Screws (210/3) unscrew and the support plate (210/2) remove.
3. Bolting device (210/1) from support plate unscrew and replace. The screws with loctite secure.
4. Support plate in reverse sequence install and the screws likewise with loctite secure.
5. Side cover attach again.

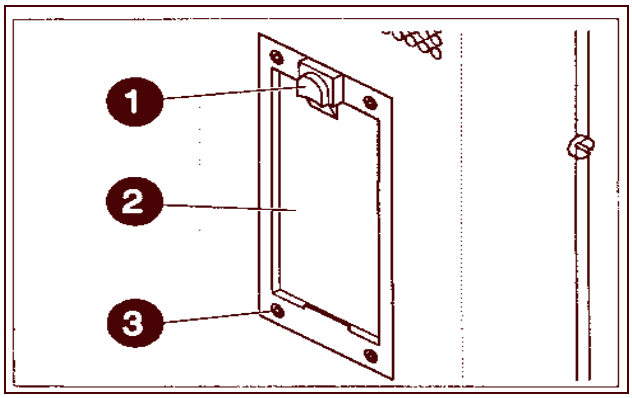


Fig. 210

3.2.6.4 Cable support changes

1. Mains connection cable of the cable support roll off complete.
2. Left side cover (211/1) after loosening of the screws remove
3. Cable support (211/2) dismantle.
4. New or repaired cable support install and the screws with loctite secure.
5. Side cover attach again.

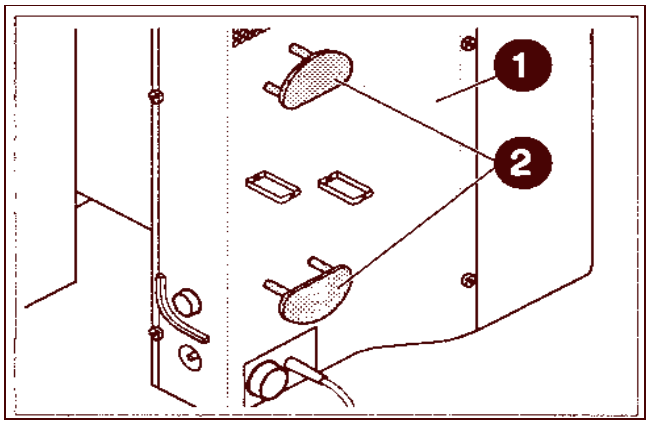


Fig. 211

3.2.6.5 Mains cable change

1. Left side cover remove.
2. Six screws of the plug plate (212/1) unscrew. The nut rail (212/2) is to be held by a second person!
3. Plug plate take out.
4. Plug plate with a screw at the nut rail fix.
5. Front cover remove.
6. The PCB rack with the PCB´s open unfold.
7. Mains cable (213/2) from the terminal strip (213/1) at the soil of the electronics block loosen. Connection points note!
8. All cable tie raps, which hold the mains cable in the wiring harness, cut through.
9. Cables with strain relief and break protection from the plug plate remove.
10. New cable in reverse sequence install.
11. Plug plate again fasten and the screws with loctite secure.
12. Mains cables at the terminal strip connect.
13. New cable tie raps install.

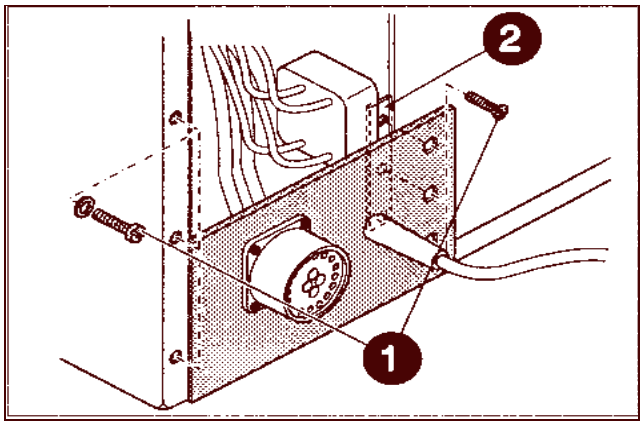


Fig. 212

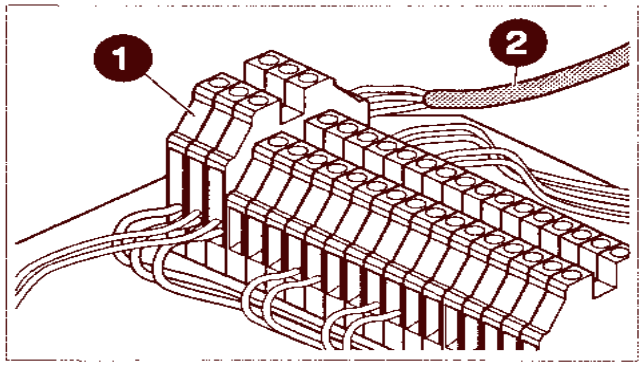


Fig. 213

3.2.6.6 Cable attachment change

1. Screws (214/1) unscrew and together with the washer lay down.
2. Cable attachment (214/2) remove.
3. Taken small articles check for re usable.
4. New cable attachment in reverse sequence install and the screws with loctite secure.

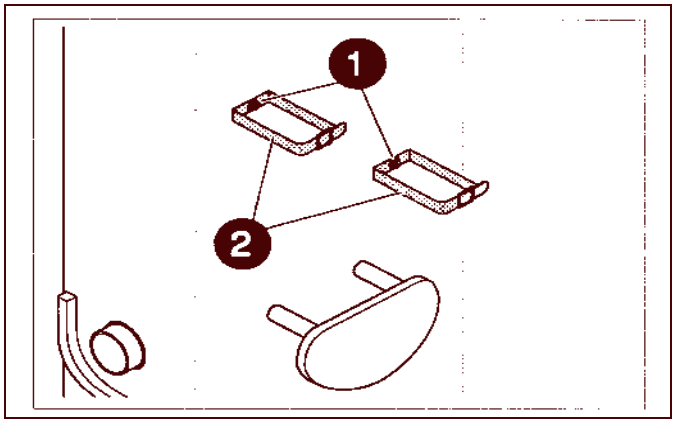


Fig. 214

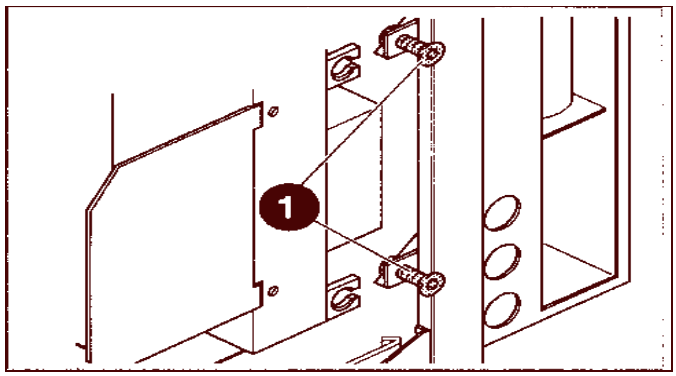


Fig. 215

3.2.6.7 Hand switch change

1. Front and lateral cover after loosening of the screws remove.
2. The two screws (215/1) loosen and the PCB rack with the PCB´s open unfold.
3. Hand switch cables of the control console disconnect.
4. Both screws (216/1) unscrew and the handle (216/2) remove.
5. Plug (217/1) of the lead loosen and the hand switch carefully take out.
6. Taken small articles check for re usable.
7. New hand switch in reverse sequence install.

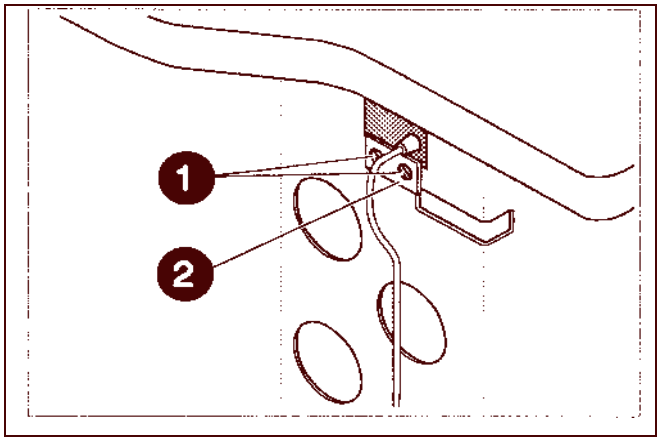


Fig. 216

3.2.6.8 Control panel change

1. Front cover after loosening of the screws remove.
2. The two screws (215/1) loosen and the PCB rack with the PCB´s open unfold.
3. All connectors of the control panel disconnect.
4. Twelve special screws unscrew and the control panel remove.
5. Taken small articles check for re usable.
6. New control panel in reverse sequence install.

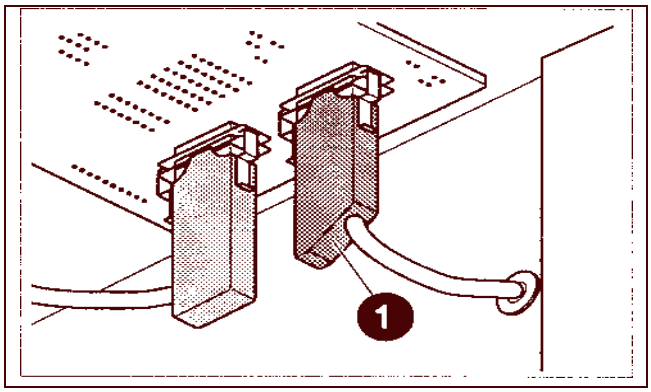


Fig. 217

3.2.6.10 Individual PCB´s change

The locations of the PCB´s are for the overview in 3.5 to can see.

3.2.7 C - arm bracket

3.2.7.1 Carrier handle change

1. The three socket head screws (218/1) unscrew and together with the lock washers lay down and the carrier handle (218/2) remove.
2. Taken small articles check for reusable.
3. The assembly of the carrier handle install in reverse sequence.

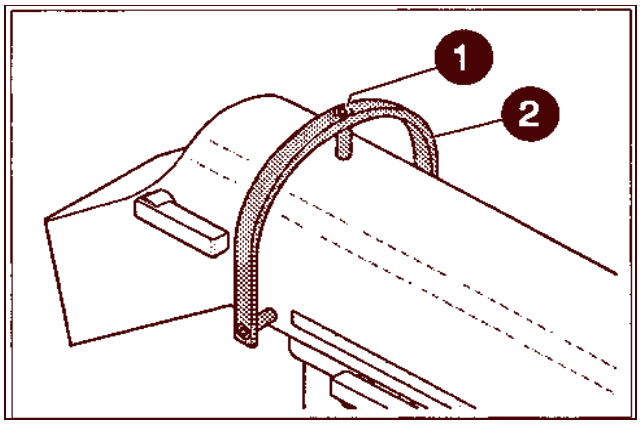


Fig. 218

3.2.7.2 Grip of the brake for the horizontal movement change

1. The socket head screw (219/1) screws out and remove the grip (219/2).
2. The assembly of the grip in reverse sequence install. Fixing bolt of the brake grip with loctite secure.

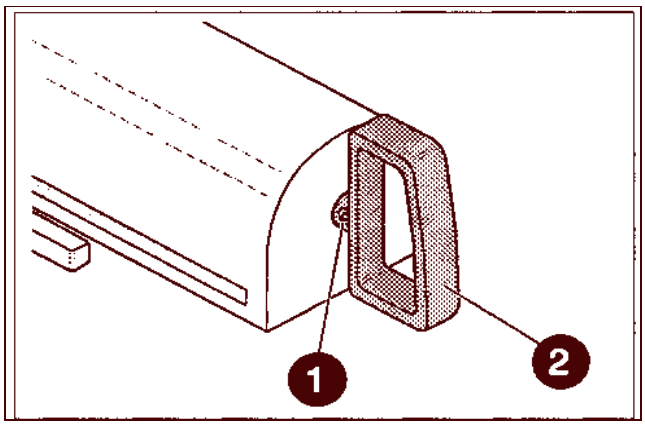


Fig. 219

3.2.7.3 Grip of the brake for rotating movement change

1. The socket head screw (220/1) of the left or right grip (220/2) unscrews alternatively and the appropriate grip remove.

2. The assembly of the grip install in reverse sequence.

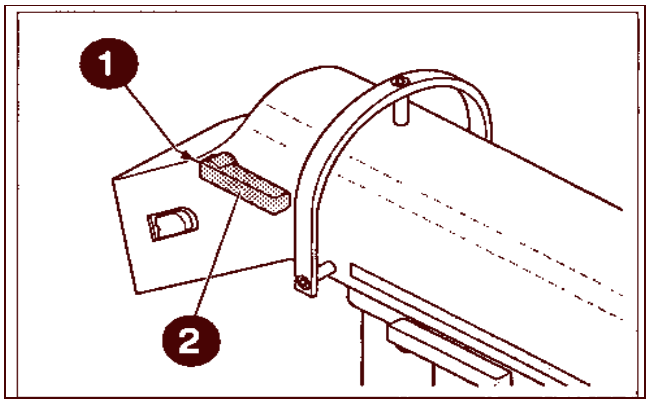


Fig. 220

3.2.7.4 Cover change

A) Upper cover

1. Carrier handle in accordance with 3.2.7.1 and the grip of the brake for the horizontal movement in accordance with 3.2.7.2 remove.
2. The six screws (221/1) unscrew and together with the washer lay down. The cover (221/2) can be taken off now to the rear.
3. Taken small articles check for reusable.

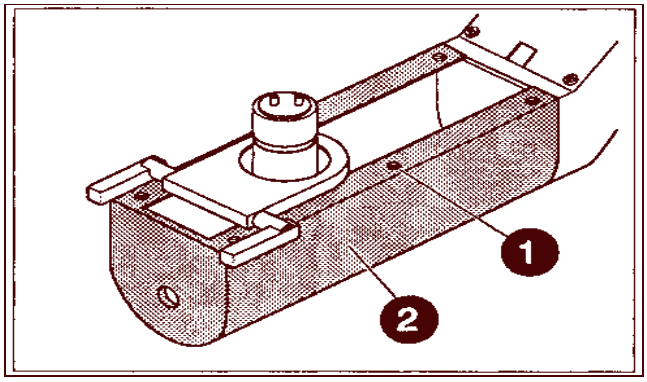


Fig. 221

4. New or repaired cover in reverse sequence install. The fixing bolt of the brake grip with loctite secure.

B) Upper cover

1. Unscrew the three screws (222/1) and remove the cover (222/2).
2. New or repaired cover attach and the screws with loctite secure.

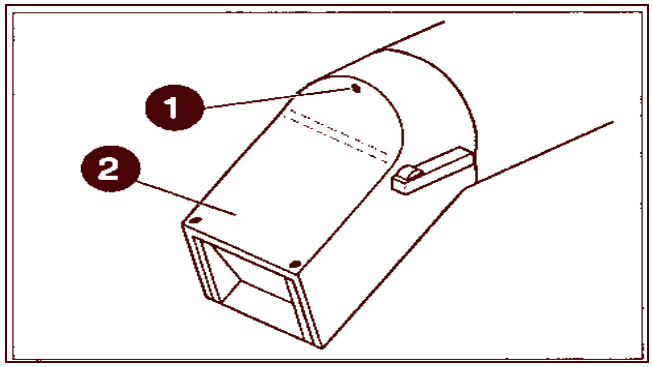


Fig. 222

C) Lower cover

1. After loosening of the socket head screw take the locking lever off (223/1).
2. The four screws (223/2) screw out and remove the cover (223/3).
3. New or repaired cover in reverse sequence install and the screws with loctite secure.
4. Locking lever install again and the screws with loctite secure.

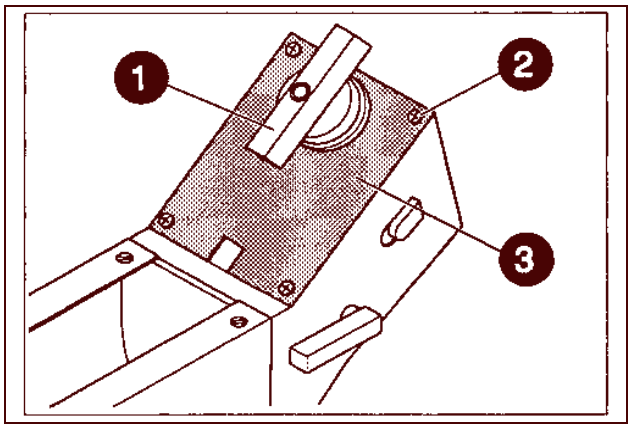


Fig. 223

3.2.7.5 Locking lever change

1. The screw (224/1) unscrew and the lever (224/2) together with the screw and the spring washer remove.
2. Taken small articles check for reusable.
3. New or repaired lever in reverse sequence install and secure the screw with loctite.

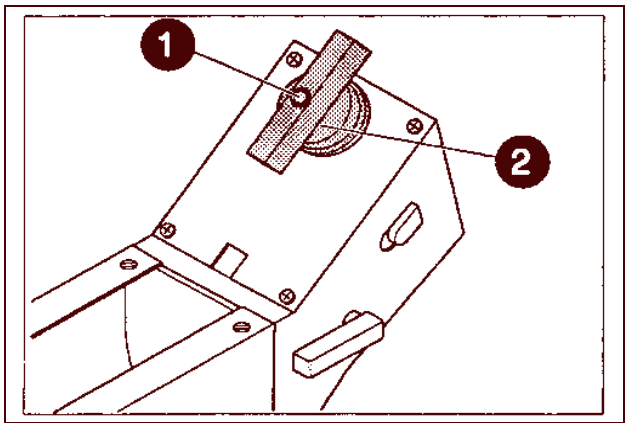


Fig. 224

3.2.7.6 Protection socket change

1. Two head screws (225/2) from the base plate (225/1) unscrews and the protection socket (225/3) together with the screws and the spring washers lay down.
2. The camps and the guide ring of the socket take out
3. Taken small articles check for reusable.
4. New protection socket in reverse sequence build up and install.

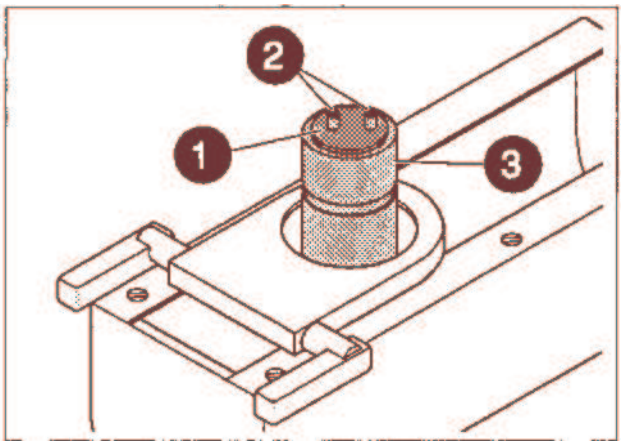


Fig. 225

3.2.7.7 Unlocking button for barrier change

1. The socket head screw (226/1) screws out and the unlocking button (226/2) removes.
2. New unlocking button in reverse sequence install.

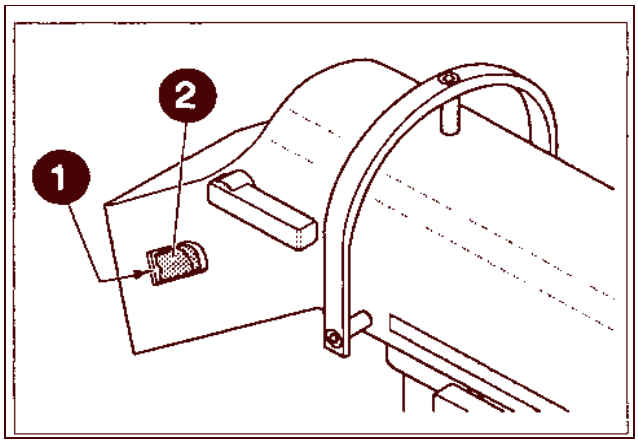


Fig. 226

3.2.7.8 Brake for rotating movement adjust

REFERENCE Representations see at Appendix C

If the braking force is < 70 Nm, the brake can be adjusted.

1. The upper cover unscrew and the brake for C – arm rotation loosen.
2. The set screws (female hexagon) loosen.
3. The tension ring in the counter clockwise direction unscrew.
4. Brake tighten and the braking force control .
5. The set screws again screw on.
6. The upper cover install.

3.2.7.9 Brake for rotating movement change

REFERENCE Representations see at Appendix C

1. The carrying handle, the grip of the horizontal brake, the both upper covers unscrew.
2. The locking lever and the lower cover unscrew.
3. The two socket head screws at the lower surface of the stop block unscrew and together with the lock washers lay down. The stop block completely take out.
4. One grip of the brake for rotating movement unscrew and the shaft pull out laterally with the camps and washers.
5. The tension ring as well as the pressure plates take out.
6. The attachment strip of the bellows unscrew.
7. The bellows to the side push and loosen the locknut of the bolt.
8. The nut of the bolt by light impacts with a hammer loosen and the bolt screwed out.
   Put two M4 - screws into the holes of the disk for the easier disassembly of the brake disk.
9. New brake disk insert. Use a new locknut for the special bolt.
10. The tension ring with the pressure plates and the stop block completely replace.
11. The brake for rotating movement install again.
12. Braking force and position of the grip in accordance with 3.2.7.8 adjust.
13. The upper and lower cover install.
14. Bellows arrange and the attachment strip install again.
15. The upper cover, carrying handle and the grip of the brake horizontal install.

3.2.7.10 Bellows at the C - arm bracket change

REFERENCE Representations see Appendix C

1. Check whether the bellows at the soil of the construction unit for horizontal movement are damaged and whether they can open and be closed correctly.
   If the bellows are damaged, they must be replaced.
2. The carrying handle, the grip of the brake for horizontal movement and the cover must be unscrewed.
3. The seven socket head screws unscrew and the end plate with the eccentric shaft remove.
4. Both bellows of the bearing block unscrew (in each case two screws at the strips with graduation scale) and the first bellows from the guide rails remove.
5. Drive out the bearing block from the C – arm bracket or drive the C – arm bracket down of the bearing block and lay down.
6. Second bellows from C - arm bracket unscrew and from the guide rails pull down.
7. New bellows in reverse sequence install.

3.2.7.11 Brake for horizontal movement change

REFERENCE Representations see Appendix C

1. Check whether the braking action is still sufficient.
2. The carrying handle, the grip of the brake for horizontal movement and the cover unscrew.
3. The seven socket head screws unscrew and the end plate with the eccentric shaft remove.
4. Four socket head screws unscrew and together with the lock washers lay down.
5. Brake disk remove.
6. Taken small articles for re usability check.
7. New brake disk in reverse sequence install.

3.2.7.12 Camps in the bearing block change

REFERENCE Representations see Appendix C

1. The carrying handle, the grip of the brake for horizontal movement and the cover unscrew.
2. The seven socket head screws unscrew and the end plate with the eccentric shaft remove.
3. Both bellows of the bearing block unscrew (in each case two screws at the strips with graduation scale) and the first bellows remove from the guide rails.
4. Drive out the bearing block from the C – arm bracket or drive the C – arm bracket down of the bearing block and lay down.
5. Four socket head screws unscrew and together with the lock washers lay down.
6. Brake disk remove.
7. The clamping screw belong laterally on the bearing block to the camp present loosen and the eccentric cam pin of the camp unscrew.
8. Camp take out.
9. The assembly of the new camp install in reverse sequence.
10. The axial champ clearance must be adjusted.

3.2.7.13 Camps in the bearing block adjust.

REFERENCE Representations see Appendix C

1. The carrying handle, the grip of the brake for horizontal movement and the cover unscrew.
2. Both bellows from bearing block (in each case two screws at the strips with graduation scale)unscrew and push together.
3. The two clamping screws on the adjusting side of the camps loosen.
4. The C - arm bracket to push a side and one of the camps adjust. The camp is correctly adjusted, if no clearance between camp role and bearing surface is present.
5. The C – arm bracket to the other side push and the other camp adjust. The camp is also correctly adjusted, if no clearance between camp role and bearing surface is present.
6. The clamping screws tighten and the bellows again fasten.
7. The cover, the grip of the brake for horizontal movement and the carrying handle again install.

3.2.8 C – arm

3.2.8.1 Handle change

1. Handle remove (227/2) after unscrew the socket head screw (227/1).
2. New handle attach and the screws with loctite secure

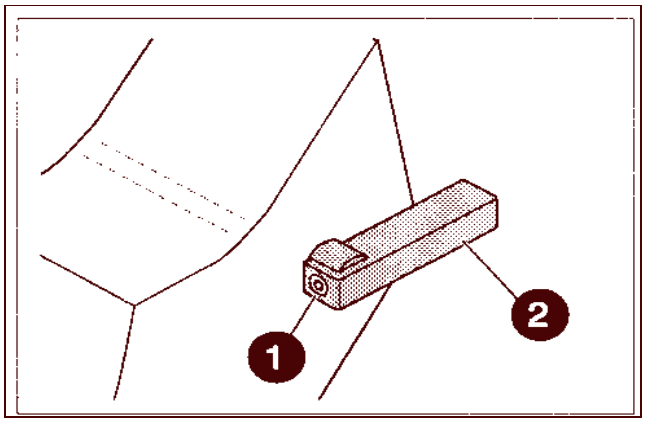


Fig. 227

3.2.8.2 Transportation barrier change

1. Transportation barrier remove (228/2) after loosening the screws (228/1).
2. The damaged part of the transportation barrier replace.
3. Transportation barrier attach again and the screws with loctite secure.

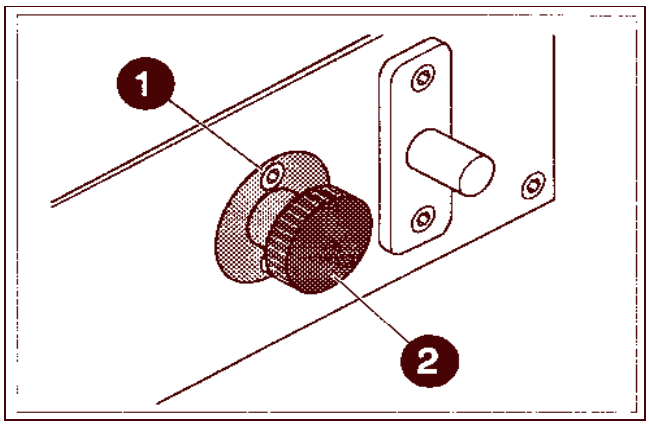


Fig. 228

3.2.8.3 Cover change

1. Transportation barrier (229/2) dismantle.
2. Handle for cable suspension after loosening of the screws (229/1) remove.
3. Cover after loosening of the screws (4 x) (229/4) remove.
4. New or repaired cover (229/3) in reverse sequence install.
5. Handle for cable suspension and transportation barrier install again and the screws with loctite secures.

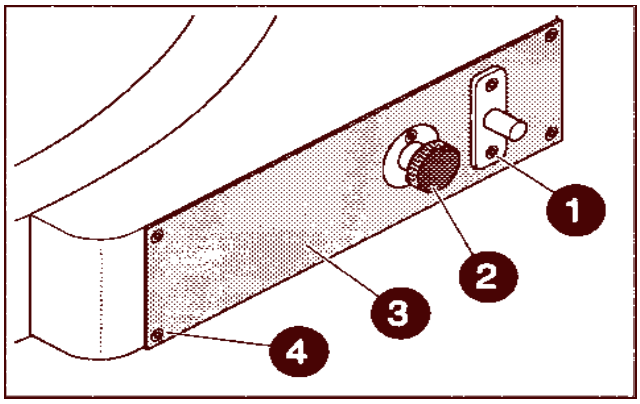


Fig. 229

3.2.8.4 Locking levers with axle change

1. Screw (230/1) unscrew and remove.
2. Washer (230/2) remove.
3. Locking lever (230/3) with axle laterally pull out.
4. New locking lever with axle insert.
5. Washer and screw put in, screw tighten.

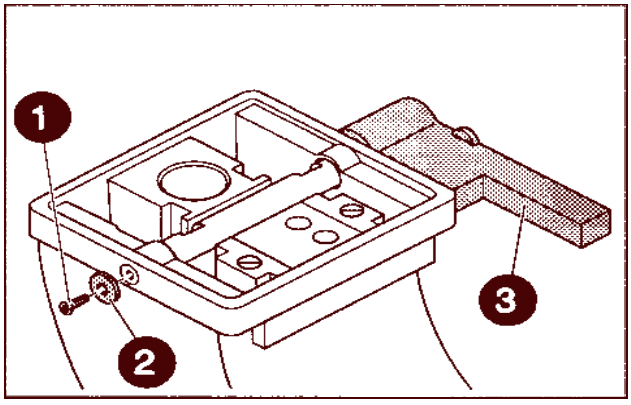


Fig. 230

3.2.8.5 Cable entry completely change

1. Two screws (231/2) at the cable entry (231/3) unscrews and together with the lock washers lay down.
2. Four socket head screws (231/1) unscrew and together with the lock washers lay down.
3. Cable entry carefully remove.
4. Taken small articles for reusability check.
5. New or repaired cable entry in reverse sequence install.

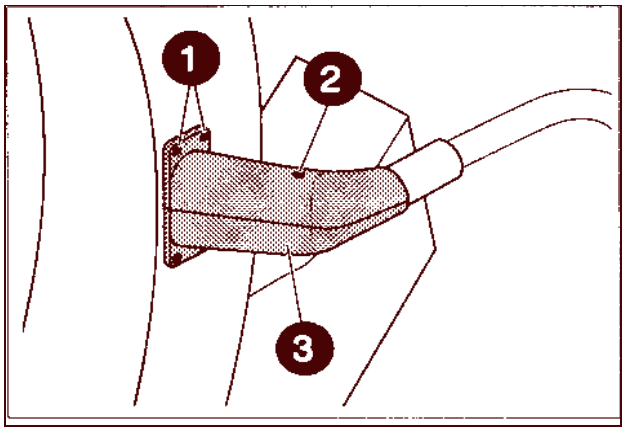


Fig. 231

3.2.8.6 Cable suspension change

1. Cable suspension (232/1) after loosening of the screws (232/2) remove.
2. New cable suspension install.
3. The screw with loctite secure.

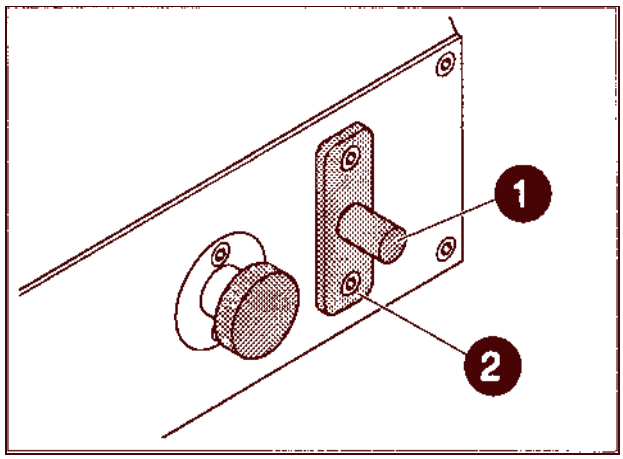


Fig. 232

3.2.8.7 Safety lock pin for cable suspension change

1. Nut (233/2) loosen and the safety lock pin (233/1) remove.
2. New pin install.

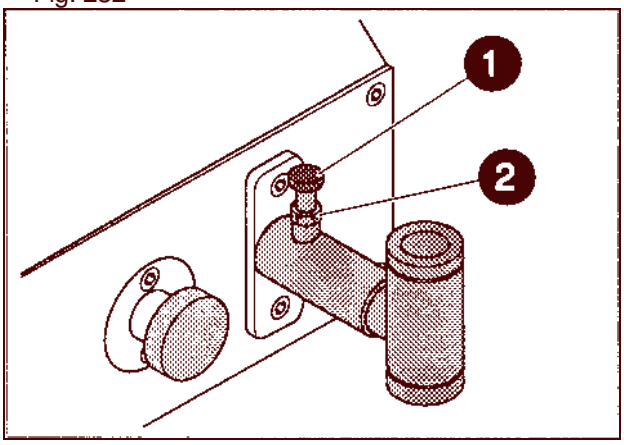


Fig. 233

3.2.8.8 Push buttons for sterilizable cover of the C - arm change

1. Damaged button carefully unscrew.
2. New button install and with loctite secure.

3.2.8.9 Brake for C – arm shift adjust

REFERENCE Representations see Appendix E

1. C - arm lay down in reverse direction and the brake loosen.
2. Transportation barrier dismantle.
3. Handles for cable suspension after loosening of the screws remove.
4. Four screws unscrew and the cover plate of the sliding block take off.
5. The two fixing screws of the brake unit loosen.
6. Four socket head screws loosen and the brake with the rubber buffer against the C - arm press.

REFERENCE When shifting the C - arm is friction perceptibly.

7. The four socket head screws tighten, until the brake with the rubber buffer straight is raised. Then one turn keep more.
8. The two fixing screws tighten and control the function of the brake.
9. Cover plate, transportation barrier and the handle for cable suspension again install.

3.2.8.10 Rubber buffers of the brake for C – arm shift change

REFERENCE Representations see Appendix E

1. C - arm lay down in reverse direction and the brake loosen.
2. Transportation barrier dismantle.
3. Handles for cable suspension after loosening of the screws remove.
4. Four screws unscrew and the cover plate take off.
5. The two fixing screws unscrew and the brake unit remove. The unit hangs on the brake bar.
6. One of the two secure rings take off and the axle carefully from the mounting plate pull out.
   To the spring tension pay attention.
7. Lock washer and wearing part from the brake buffer remove and the brake buffer replace.
8. The assembly of the new brake buffer install in reverse sequence.
9. The brake is to be adjusted in accordance with 3.2.8.9.

3.2.9 Image intensifier unit

3.2.9.1 Camera cover change

1. Three screws (234/8) unscrews and with the high locking collar, grounding washers (234/6, 234/7) and the locking washers (234/2) remove.
2. Two screws (234/5) unscrew and with the grounding washer remove.
3. Handle (234/1) and camera cover (234/3) take off.
4. Camera cover repair or replace.
5. Taken small articles check for re usability.
6. Camera cover in reverse sequence install.

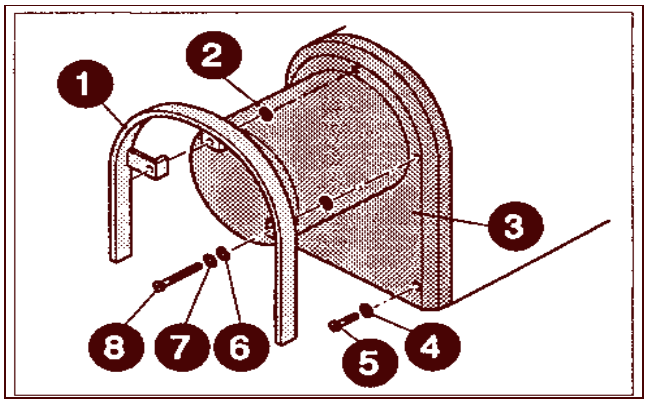


Fig. 234

3.2.9.2 Raster change

1. Position of the raster before removing mark.
2. Four screws (235/2) unscrew and the raster (235/1) remove.
3. Taken small articles check for re usability.
4. New raster in reverse sequence install.

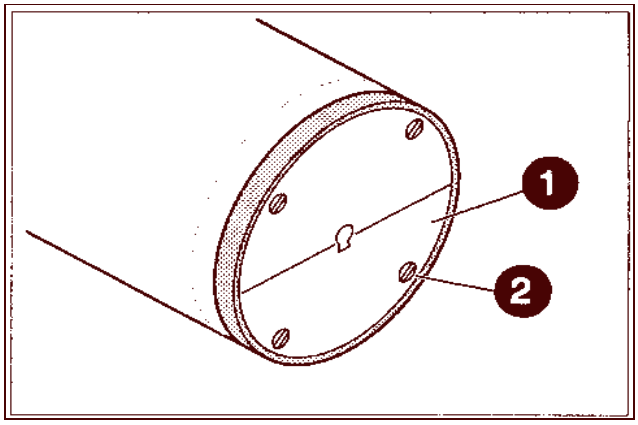


Fig. 235

3.2.9.3 High voltage plugs take new grease

1. Camera cover in accordance with 3.2.9.1 remove.
2. Screws (236/1) loosen. The screws are captive connected with the hinge (236/2).
3. The high voltage plug with pliers carefully take out.
4. Plug (237/1) clean and within the coated range (237/2) spread with silicone grease.
5. The plug insert again carefully into the guidance and the screw tighten again.

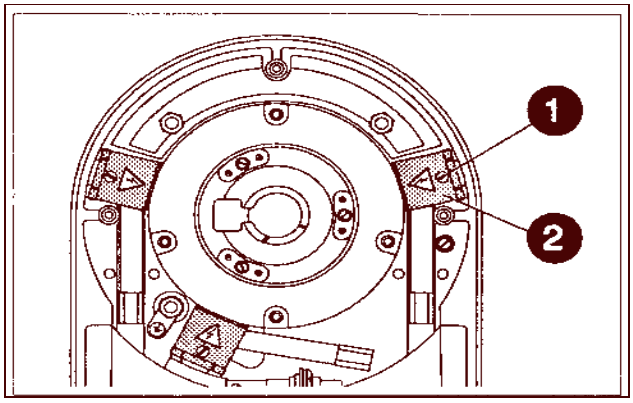


Fig. 236

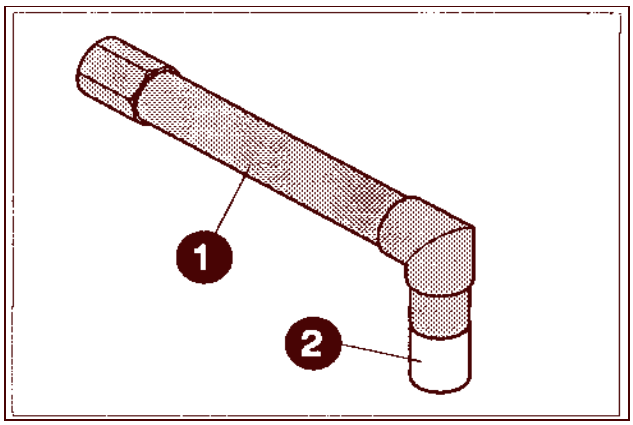


Fig. 237

3.2.10 Collimator

3.2.10.1 Knob change

1. Screen up to the stop closes.
2. Plastic cap (238/3) from the knob remove.
3. The nut (238/2) unscrew and the knob (238/1) remove.
4. New knob in reverse sequence install

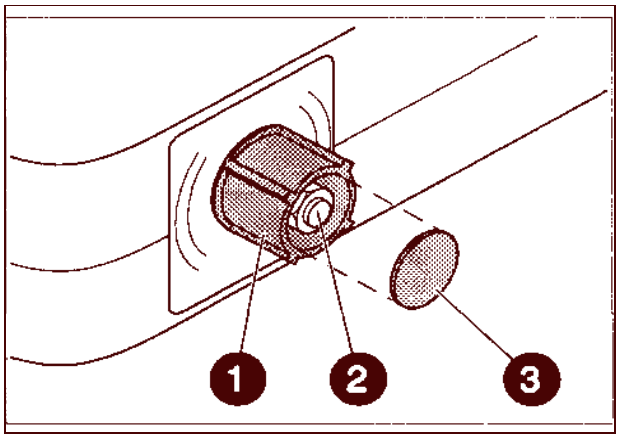


Fig. 238

3.2.10.2 Clutch plate change

1. Clutch plate (239/1) after loosen of the six screws (239/2) remove.
2. New clutch plate install.

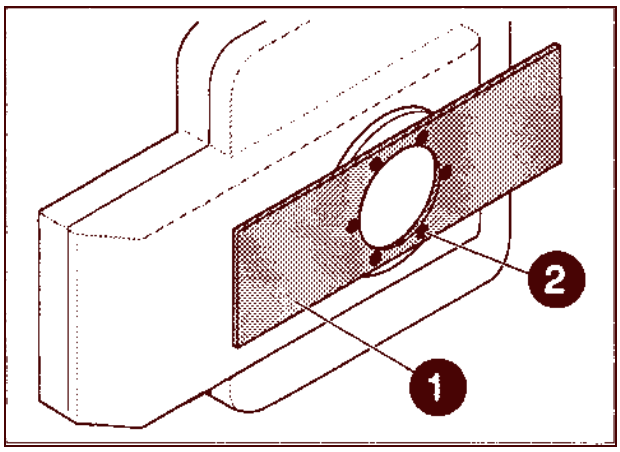


Fig.239

3.2.10.3 Halogen bulb change

1. Plug of the installed collimators disconnect and the halogen bulb leaves cooling down.
2. Bolting device (240/1) unscrew and the cover take off (240/2).
3. The halogen bulb (240/3) carefully pull out from the socket.

ATTENTION
The new halogen bulb when inserting do not touch with the bare hands!

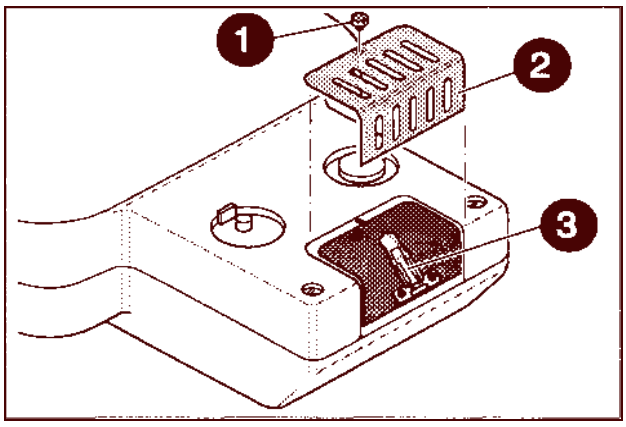


Fig.240

4. The new lamp straight install and the cover fasten again.
5. The collimator to install a developed X – ray unit and align to the image intensifier unit.
6. The light switch on. The center of the spot must be positioned on the axle center of the image intensifier unit.
7. Collimator dismantling.

3.2.11 Trolley

3.2.11.1 Wheel change

1. Wheel with mounting plate after loosen of the four screws (241/1) remove.
2. New wheel install.

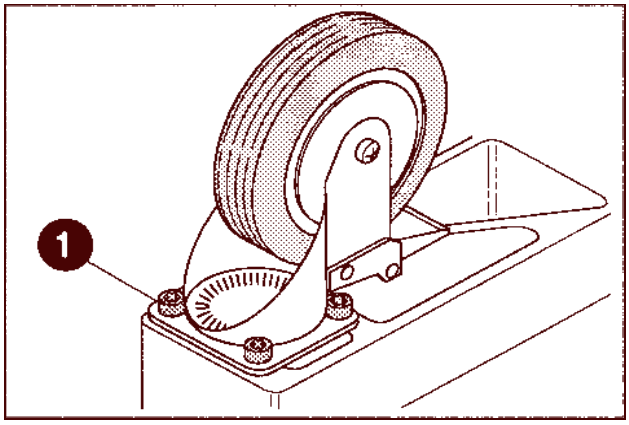


Fig. 241

3.2.11.2 Attachment knobs change

1. Securing ring (242/2) remove.
2. Attachment knob (242/1) take off and a new knob install.

Attention

The washer (242/3) must be install in the correct sequence.

3. Securing ring again attach.

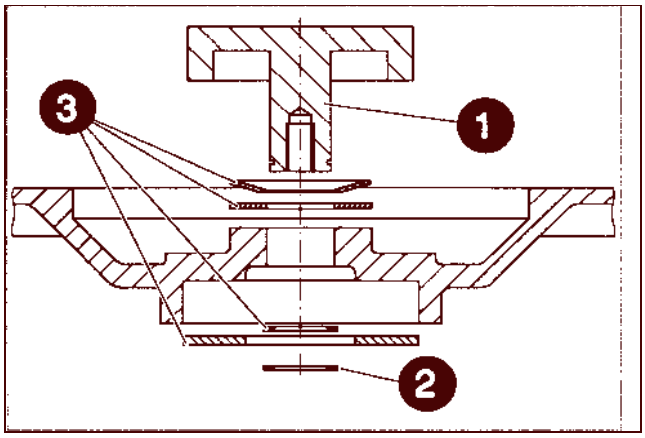


Fig. 242

3.2.12 Bit map memory unit

3.2.12.1 Bit map memory unit opening

1. The eight plastic caps (243/1) with a screwdriver put out and the screws which are under it unscrews.
2. All connections from the sockets on the back loosen.
3. The bit map memory unit forward pull out of the housing.
4. Taken small articles for reusability check.
5. The assembly take into reverse sequence.

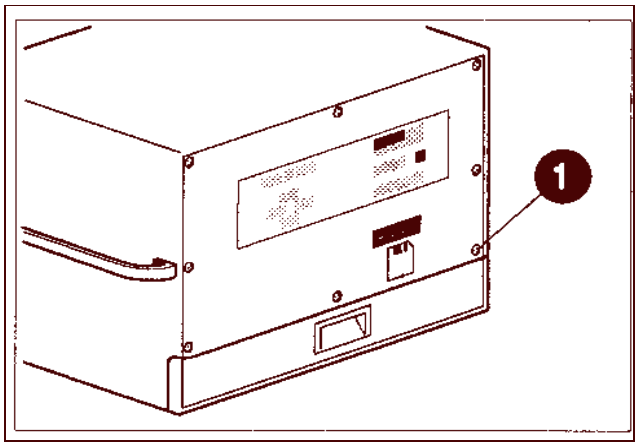


Fig. 243

3.2.12.2 Handle of the bit map memory unit change

1. Bit map memory unit in accordance with. 3.2.13.1 open.
2. The four screws (244/1) of the inside of the bit map memory unit from the handle unscrew and together with the washer lay down.
3. The handle (244/2) remove.
4. Taken small articles for re usability check.
5. The assembly of the handle take into reverse sequence.

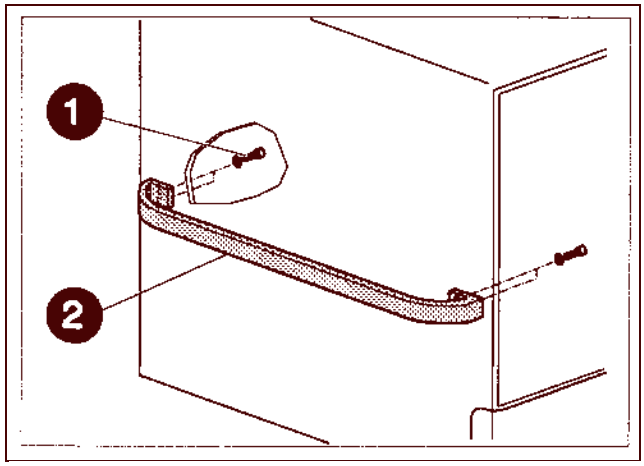


Fig. 244

3.2.12.3 Individual PCB´s change

The locations of the individual PCB´s are for the overview in 3.5 to be taken.

3.2.13 Display Unit

3.2.13.1. Carrier handle change

1. The display unit on the work surface put down (not use the tap hanger).
2. From the center of the cover plate (245/2) unscrew the screw (245/1) and together with the cover plate lay down.
3. Both fitted screw (245/5) unscrew and together with the compression springs (245/6), grip (245/3) and the outside friction washer (245/4) lay down.
4. Taken small articles for re usability check.
5. The assembly of the carrier handle takes place into reverse sequence.

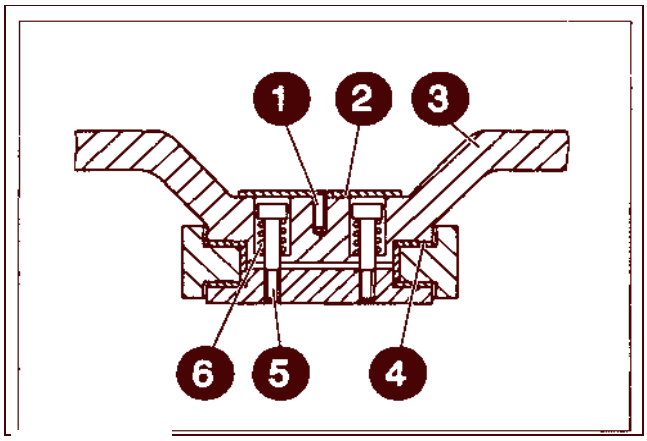


Fig. 245

3.2.13.2 Friction washers change

1. Two carrying handles and outside friction washer dismantle.
2. The guide rings (246/1) from hang up handle (246/2) remove.
3. The hang up handle easily bend upward and remove.
4. Internal friction washer (246/3) replace.
5. Taken small articles for re usability check.
6. The assembly install into reverse

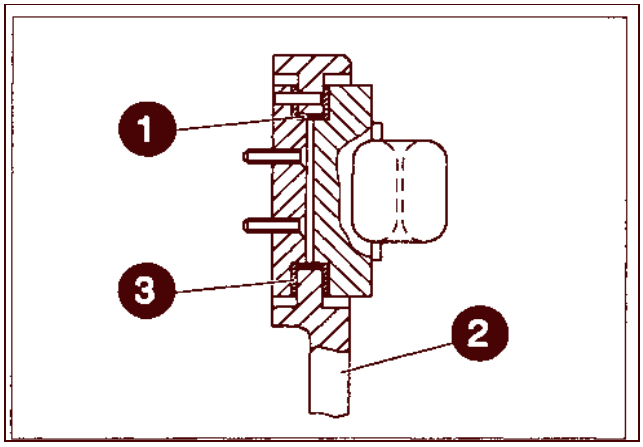


Fig. 246

3.2.13.3 Rotary knob/buffers of the hang up mounting change

1. The display unit on the work surface put down (not use the tap hanger).
2. The snap ring (247/5) of the axle of the rotary knob (247/1) remove.
3. The socket and the washer (247/4) from the rotary knob take out.
4. The rotary knob with the spring (247/2) pull out from the socket (247/3).
5. Rotary knob/buffer change.
6. Taken small articles for re usability check.
7. The assembly of the rotary knob/buffer install in reverse sequence.

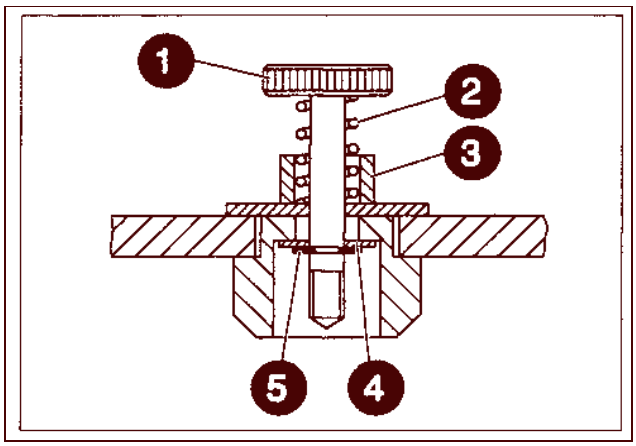


Fig. 247

3.2.13.4 Lamp in the power switch change

1. The green plastic cap (248/1) takes off.
2. Lamp (248/2) carefully pull out of the socket.
3. New lamp install.
4. Green plastic cap attach again.

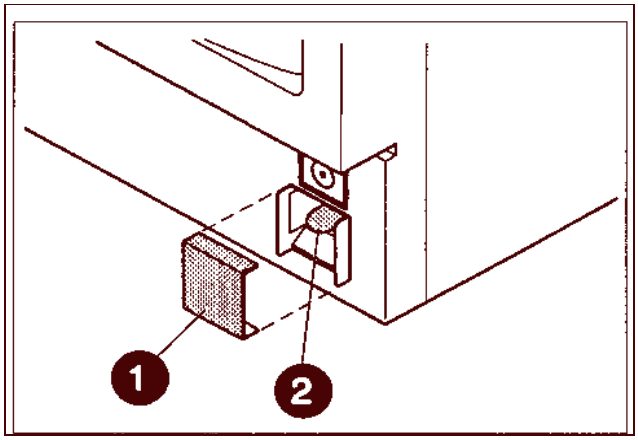


Fig. 248

3.2.13.5 Lamp in the radiation indicator change.

1. Connection between the radiation indicator and the display unit disconnected.
2. The cap of the radiation indicator unscrew.
3. The lamp leave cooling down.
4. The new lamp put in and the cap install again.

3.2.13.6 Fuse change

1. Display unit by loosening of the four screws of the housing cover on the back open.
2. The fuse take out of the fuse holder and replace.
   Fuse in screw fuse holder (249/2):
   Between interference filter and switch fuse on the power supply PCB (249/1):
   Fuse +175 VDC from the power supply
3. Position of the rocker switch (3.2.14.4) check and the display unit close.

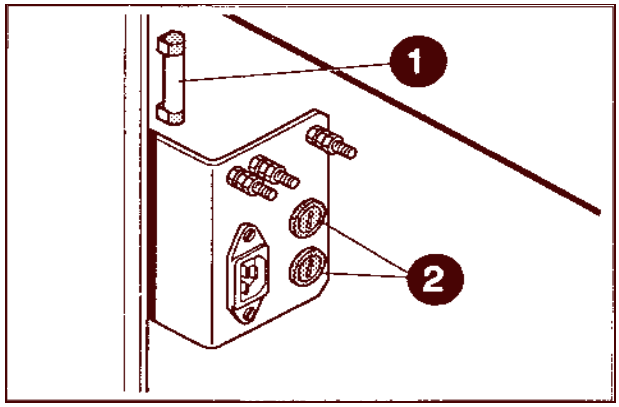


Fig. 249

3.2.13.7 Rocker switch check

1. Display unit by loosening of the four screws of the housing cover on the back open.
2. The rocker switch (250/1) on the basic PCB must positioned with the shift lever to the right side.
3. Display unit close.

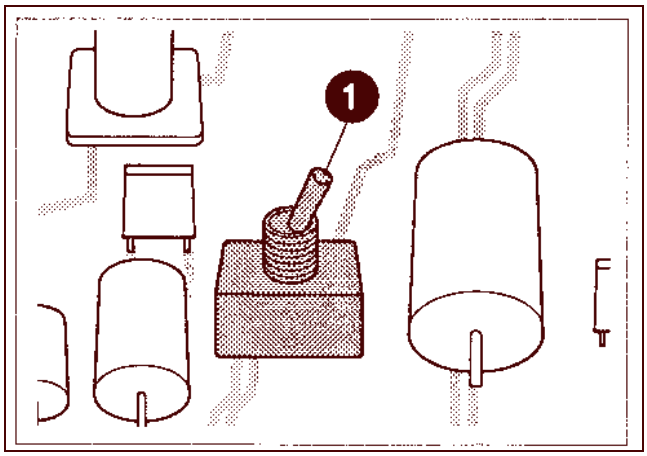


Fig. 250

3.3 System description

The X - ray system consists essentially of:

- X - ray unit
- Display unit

3.3.1 X - ray unit

3.3.1.1 Electronics block

(1) Mains regulation control unit

The X - ray unit is attached over an insulating transformer to the mains under control by the mains regulation control unit. The leakage current is lowered in such a way to less than 100 µA. The power supply transformer generated the following power supply voltages for the X - ray unit and the display unit.

594	V AC for powering the DC inverter stage
220	V AC for the display unit, the bit map memory unit and the power supply units
28	V AC for the power regulation and control PCB
12	V AC for the collimator

(2) Power supply

The power supply generated individual DC voltages for the electronics block.

(3) X-ray control unit

The X-ray control unit is controlled by a microprocessor. It translates and transfers the instructions entered over the control panel to the individual components.
For the fluoroscopy can be used both, the hand and the double foot switch; for the radiography exposure release only can be used the hand switch.

(4) APR regulation

The APR regulation (**A**natomical **P**rogrammed **R**adiography) it is to serve for the easier setting of the kV and mAs values in the radiography operation. Programmed kV and mAs values for the lateral or frontal exposure of a patient can be selected.

(5) X - ray generator

A DC - inverter supplies the primary voltage for the X – ray source. The pure DC voltage of the DC inverter produced substantially higher x-rays during normal power supply. The frequency of 300 cps makes the use possible of a smaller and lighter high voltage transformer.

(6) Control panel

The control panel can be divided into the ranges

- control
- fluoroscopy
- radiography

All push button and display are clearly located on the control panel. The function of the individual push button is explained in the part 2 of this manual.

3.3.1.2 C – arm with cable

All movements of the C – arm must be made by hand. The locking mechanism for the propeller -, fan and circle movement of the C - arm can be operated from both sides. For the locking of the forward/backward motion only one lever is present.
The C – arm cable is attached with a multiple plug at the electronics block.
At the ends of the C - arm the assembly units for the X-ray source and image intensifier unit (included plug, guide pin and turning ring head) are installed.

3.3.1.3 Image intensifier unit

The image intensifier unit contains a image intensifier tube for transformation of the X-ray into a light sample at the fibre optics output screen. The light sample is changed afterwards with a video camera into a video signal. The high voltage for the image intensifier tube is generated in a cascade generator.

3.3.1.4 X-ray source

The X-ray source contain an x-ray tube with fixed anode and double focal spot

- 0.6 mm for fluoroscopy
- 1.6 mm for radiography

The supply voltages can be appropriate between 40 kV and 105kV.

The tube current amount to:

- max. 3.0 mA for continuous and pulsed fluoroscopy
- max. 7.3 mA for snapshot
- constantly 20 mA for radiography

The X-ray source- contains further an iris screen and half permeable screen slide gate. Both screens can be controlled via the push buttons at control panel at the electronics block.

3.3.1.5 Collimator

On the top side of the X-ray source a collimator can be installed for make exposure by radiography operation. The collimator contains lead slide gate valves for the delimitation of the X-ray, a X – ray beam simulation light and a tape measure for the determination of the focus - film distance its also build in.

3.3.2 Display unit

3.3.2.1 Mobil trolley

The mobil trolley consisting of the basic frames, desk top carrier and support plate, the basic frame is equipped with two fixed and two tiltable wheels with brakes.

3.3.2.2 Bit map memory unit

The bit map memory unit contain RAM memory area for store two fluoroscopy pictures, picture improvement functions and a floppy disk drive for 3 1/2 "1.4 MB HD floppy disks. The bit map memory unit is equipped with its own power supply. The control panel is integrated into the front plate.

The picture can be limited with black video signal screens.

3.3.2.3 Display unit

The display unit contains an optical sensor for the automatic brightness and contrast regulation and a push button set (3 buttons) for picture rotation. The operation can be used alternatively by the bit map memory unit or the electronics block.

3.4 Error messages

On the indication area for fluoroscopy time can be represented two kinds of error messages:

- non-ready condition
- alarm condition

The x-ray is blocked in each case.

3.4.1 Not ready conditions

Error 1: High voltage not ready

The high voltage of the X – ray source is < 40 kV.

Error 2: Display unit not ready

Appears during switching on the display unit. After approx. 18 sec. generated the display unit an acknowledge signal and the error message expires.

Error 3: Screen not ready

This message appears:

- the screen field size by fluoroscopy operation is not lower then 15 cm
- the focal point not correct
- the screen diameter for exposure format not correct
- the gap size for exposure not >= 40 cm

Error 4: Bit map memory unit not ready

Appears during switching on the bit map memory unit, during Floppy disk drive assembly functions and background memory functions. After the production of an acknowledge signal the error message expires.

Error 5: System power supply not ready

All power supply voltages are supervised by a detector. If one or more power supply voltages are not correctly or not at all present, the detector detected this (not 2.63 V ±5%) and the error message appears.

Error 6: Not-ready because of general resetting

Appears during the first 0.1 s by switching on the X - ray unit.

Error 7: not used

Error 8: Fluoroscopy timer not ready

Does appear, if the fluoroscopy timer reached the time limit of 9,6 min. The message can be deleted by longer pressing of the reset key.

Error 9: X- ray unit not ready

Appears, if no collimator or tubus is installed or the X-ray source with installed tubus is turned.

3.4.2 Alarm conditions

The x-ray is blocked, the lamp over the “On” push button flashes, the KV value to 40 kV is adjusted and the error code on the display for fluoroscopy time represented.

Error 1: HV Generator unit alarm

The message appears, if the HV-generator unit for the image intensifier tube recognizes that the voltage or the current is too high.
The alarm can be reseted with the “On” push button.

Error 2: Heater (filament) alarm

The message appears, if the filament current is too large (heater elements short-circuit) or the filament voltage is too high (heater element broken).
The alarm can be reseted with the “On” push button.

Error 3: Inverter alarm

The message appears, if the current is too large to the X – ray source (short-circuit). The alarm can be reseted with the “On” push button.

Error 4: Mains voltage regulation unit alarm

The message appears, if mains voltage is out of the range of tolerance. The alarm cannot be represented on the display area, because the X - ray unit switched itself off. On the PCB “WA1” (placed at the lower position in the electronics block) is located an LED for displaying this alarm.

Error 5: Temperature alarm

The X – ray source temperature is measured with a NTC resistor in the X – ray source. At temperatures over 75 °C the temperature alarm appears and the radiation is blocked.
The alarm expires, if the X – ray source temperature dropped under 68 °C.

Error 6: Timer alarm

The message appears, if the limit value of the radiography timer is passed (4.2 s with radiography exposure or. 1 s with dental exposure). The alarm can be reseted with the “On” push button.

Error 7: Clock alarm

The message appears, if the clock frequency (600 cps) becomes smaller than 200 cps.

Error 8: External alarm

The message appears, if the connection is disturbed to the electronics block from control panel. It is indicated not on the display area it is indicated with LED´s on the control PCB.

Error 9: not used

3.5 Installation overview

In the following is represented the locations of the individual PCB´s in the X - ray unit, the bit map memory unit and in the display unit.

3.5.1 Electronics block

3.5.1.1 Electronics block control consol

Nr.	PCB - description	Function
1	SB1	Control panel
2	SB 2	Control panel controller
3	SB 3	Control panel vertical movement left
4	SB 4	Control panel vertical movement right

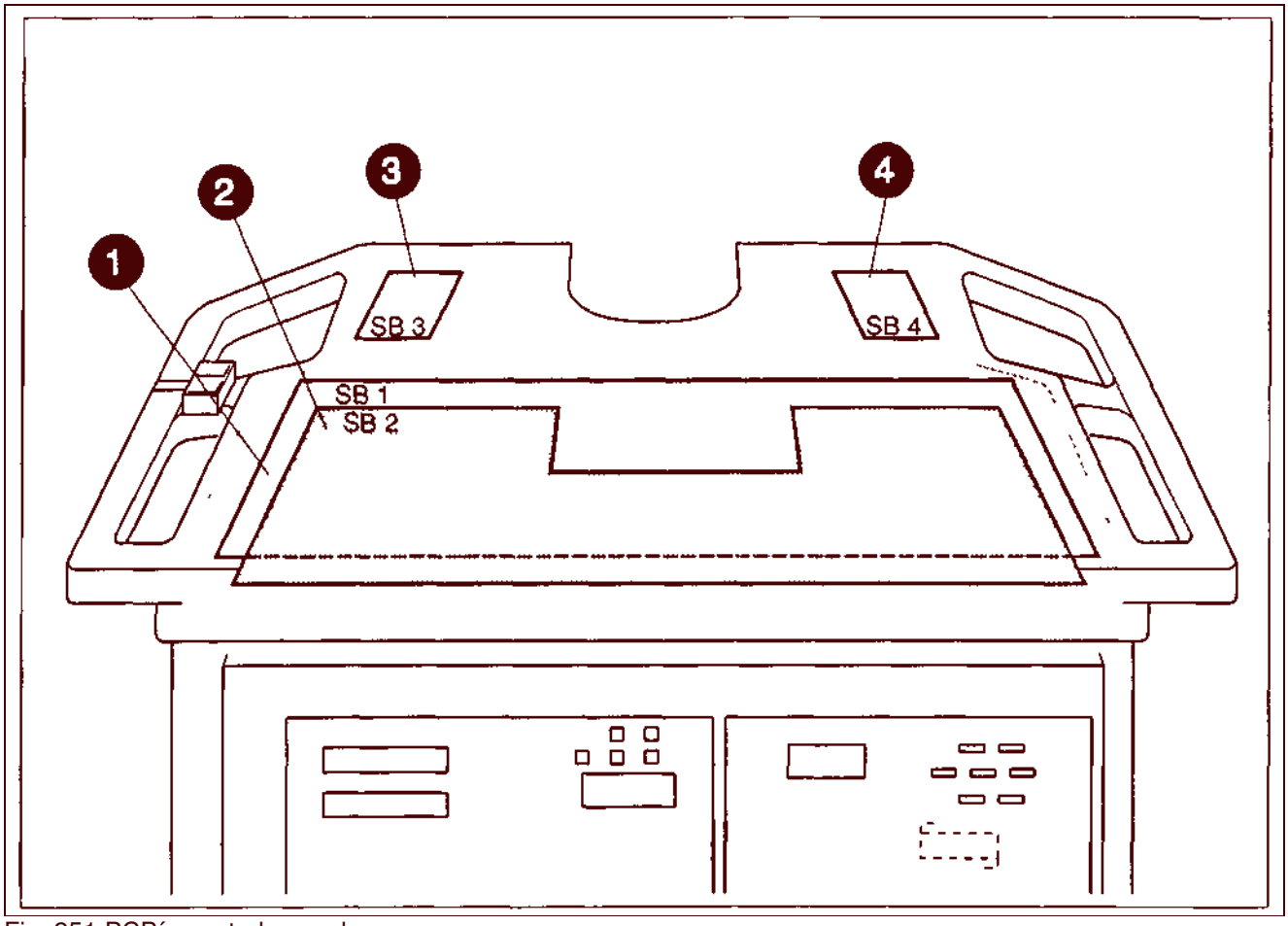


Fig. 251 PCB´s control consol

3.5.1.2 Electronics block WA unit

Nr.	PCB designation	Function
1	WA1	Mains control 1
2	WA 2	Mains control 2

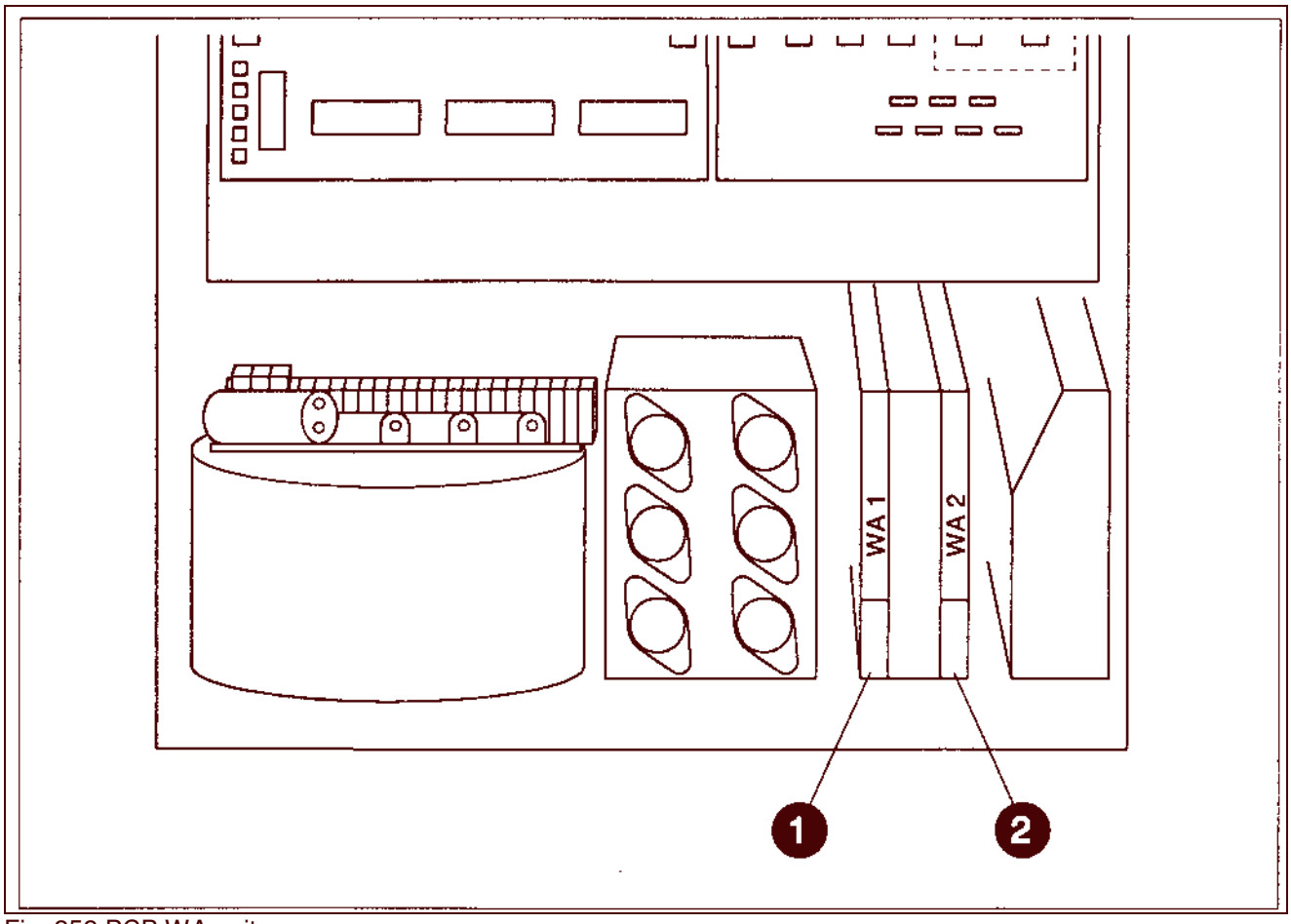


Fig. 252 PCB WA unit

3.5.1.3 Electronics block door front side

Nr.	PCB designation	Function
1	SE10	Backplane
2	SE11	Not used
3	SE13	XRC-Control
4	SE15	Generator & Error Processor
5	SE17	Radiography & Flouroscopy. Processor
6	SE19	KV and mA control
7	SE21	Diaphragm Control 1
8	SE23	Diaphragm Control 2
9	SE30	Backplane
10	SE31	Filament supply
11	SE33	Power control
12	SE35	Rectifier power
13	SE37	Inverter power 1
14	SE39	Inverter power 2

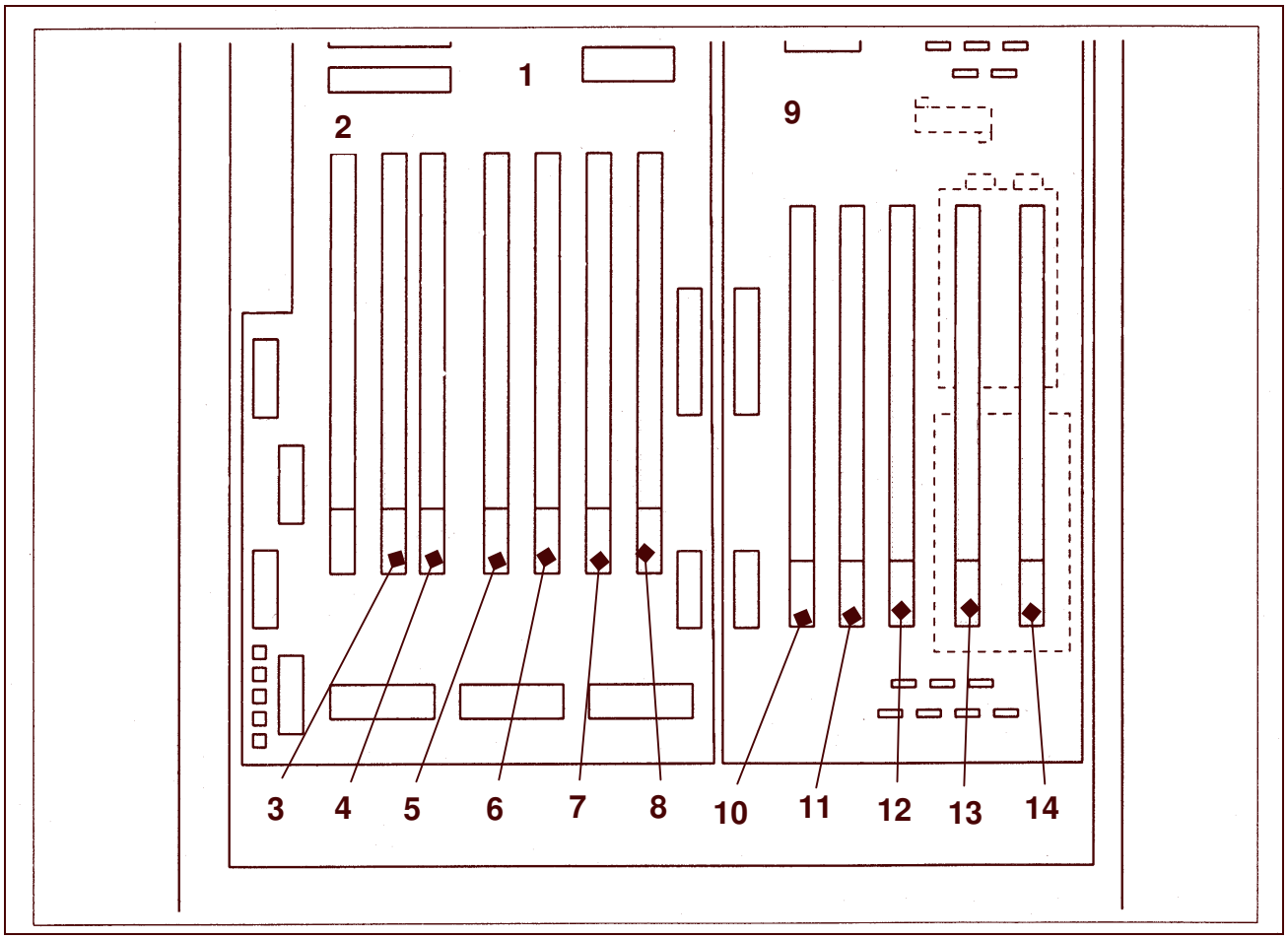


Fig. 253 PCB´s electronics block door front side

3.5.1.4 Electronics block door rear side

Nr	PCB designation	Function
1	SEC1	Capacitor
2	WN	Backplane
3	WN11	Camera control
4	WN13	Video processing
5	WN17	Adc/id processing
6	WN19	Pulse generator
7	WN21	Monitoring I/F
8	WN22	KV Control I/F
9	WN23	Adaption I/F

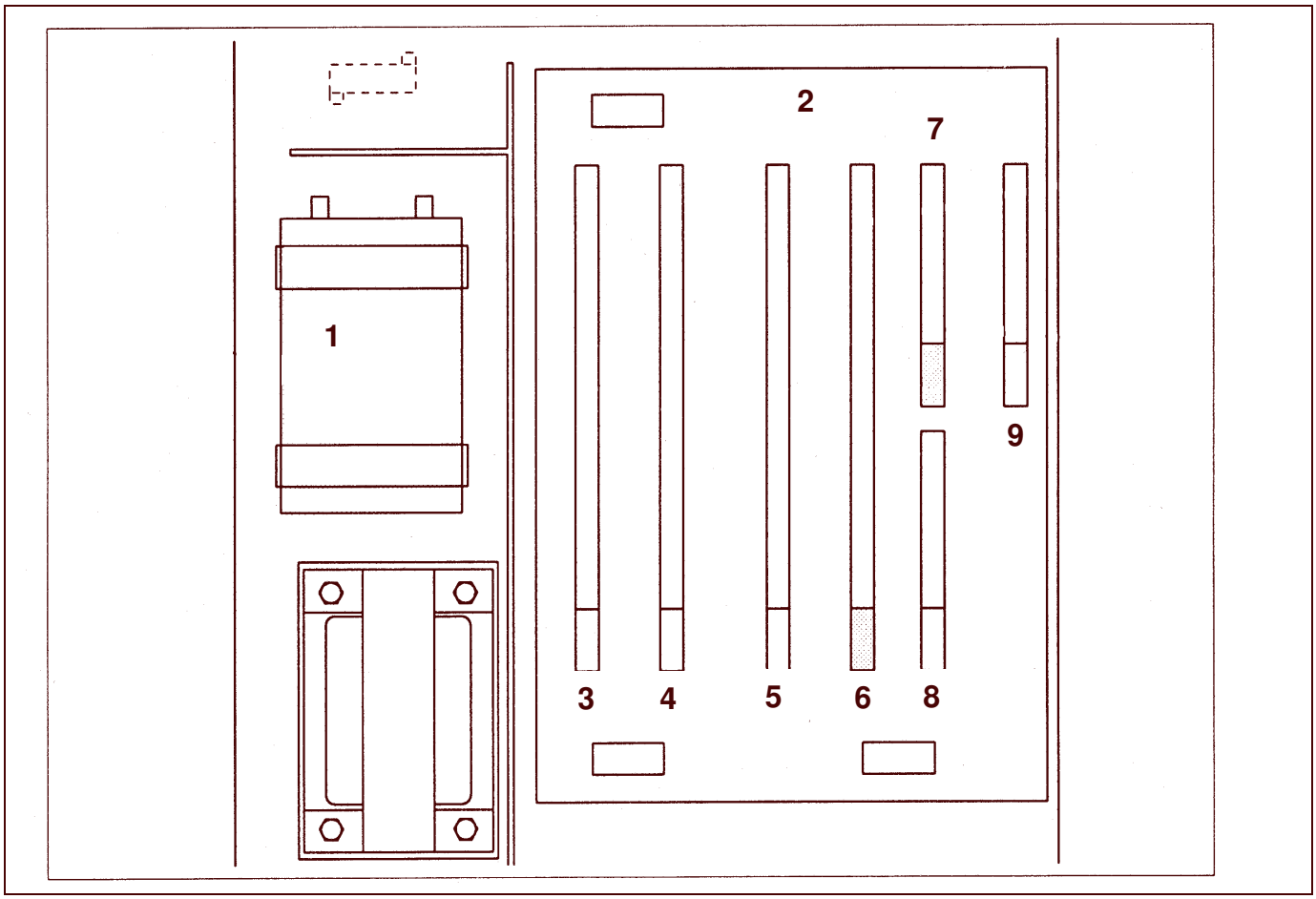


Fig. 254 PCB´s electronics block door rear side

3.5.1.5 Electronics block framework right

Nr.	PCB designation	Function
1	SU1	Power supply (Weir)
2	SM1	Vertical movement control
3	MPC	Main protection

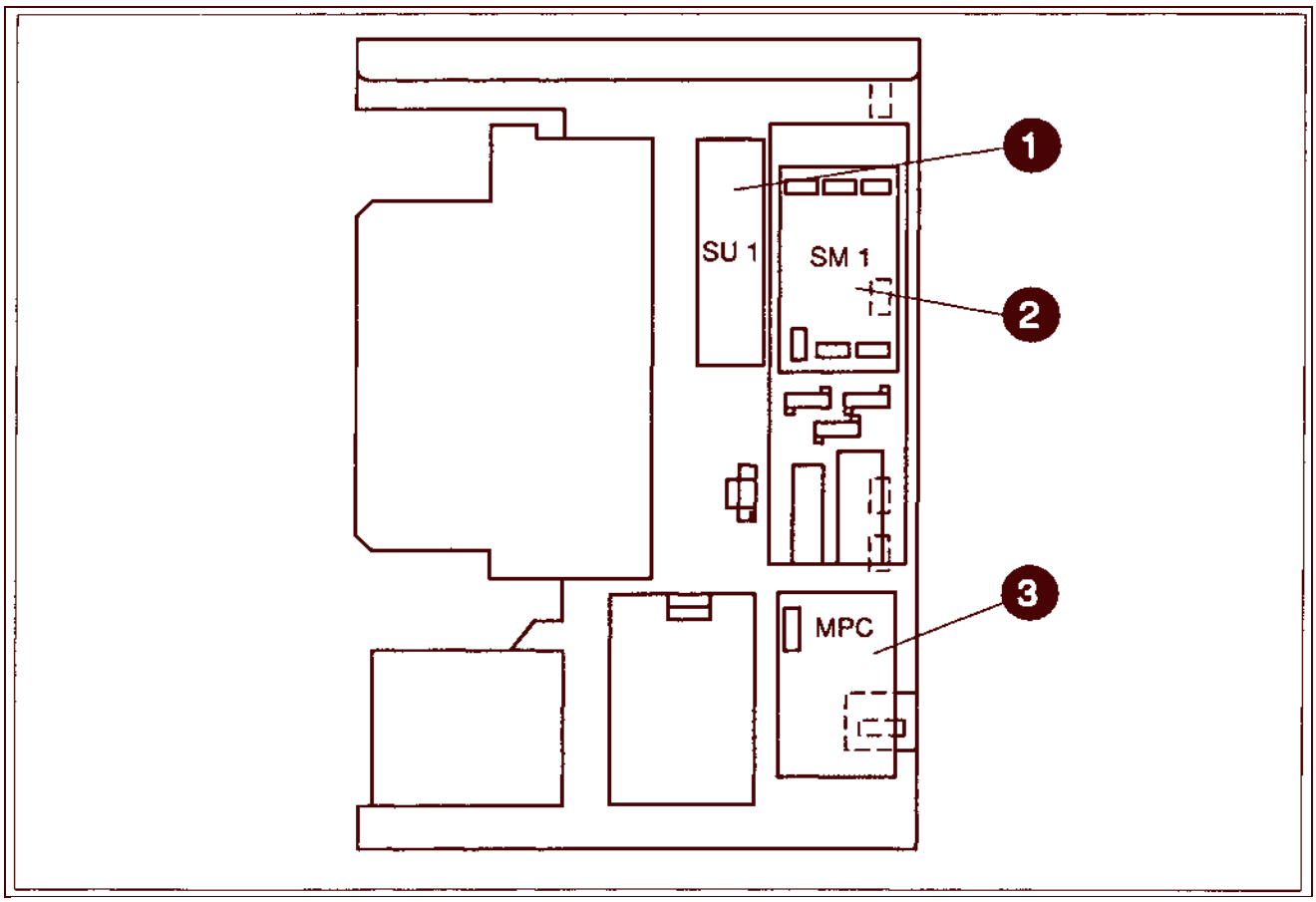


Fig. 255 PCB´s electronics block framework right side

3.5.2 Bit map memory unit

3.5.2.1 Bit map memory unit front

Nr.	PCB designation	Function
1	WB1	Control consol
2	WB2	Floppy disk display
3	WF	Floppy disk drive

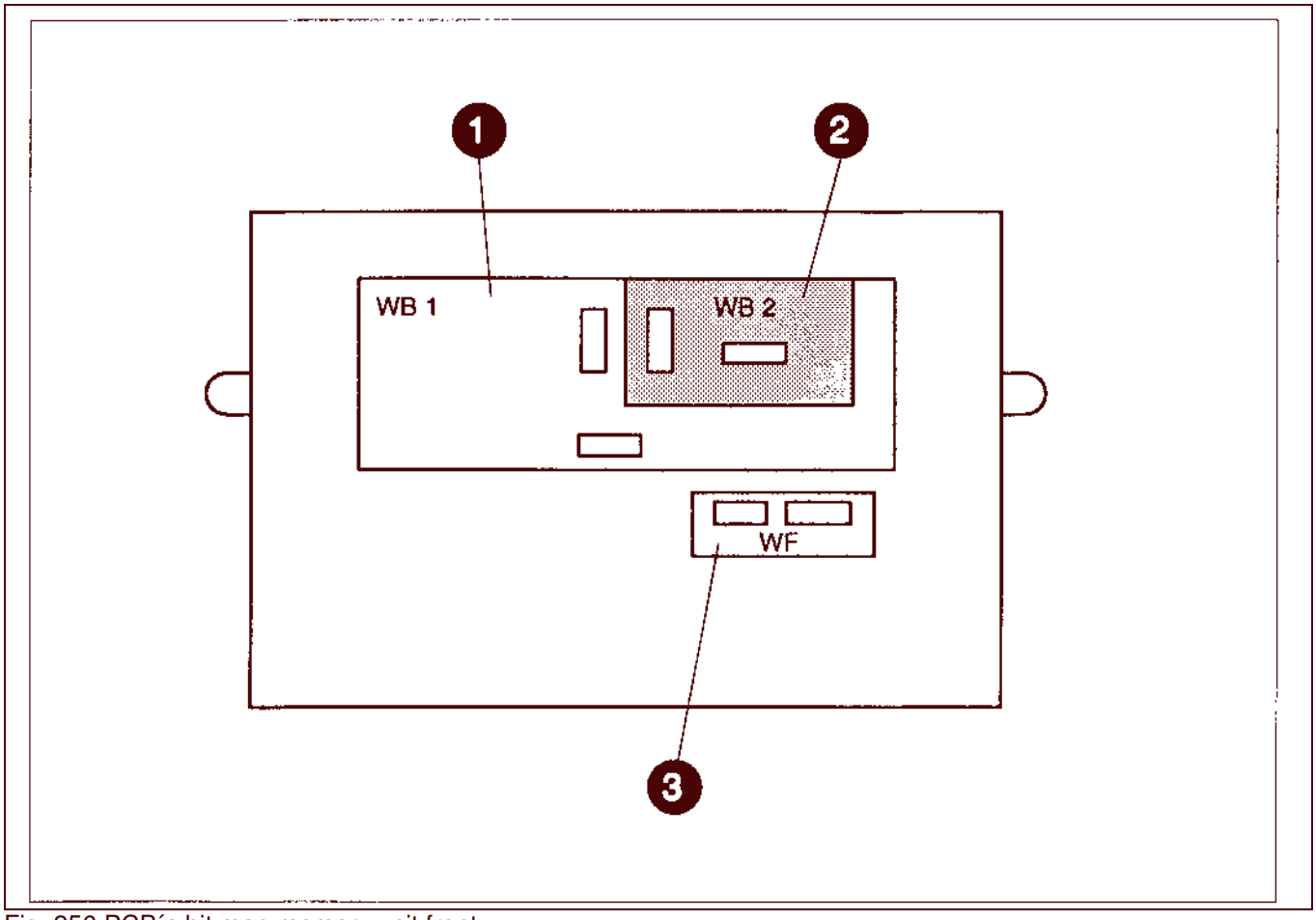


Fig. 256 PCB´s bit map memory unit front

3.5.2.2 Bit map memory unit inside

Nr.	PCB designation	Function
1	WHD 10	Backplane
2	WHD 11	ADC
3	WHD 13	Noise reduction
4	WHD 15	Video memory 1
5	WHD 17	Video memory 2
6	WHD 19	Subtractor
7	WHD 23	Floppy controller
8	WHD 25	System controller & FP I/F
9	WHA 1	Memory box control
10	WT	Front panel
11	WT 1	Relay control
12	WT 2	Fuse tester
13	WB 1	Push button PCB
14	WB 2	Display PCB

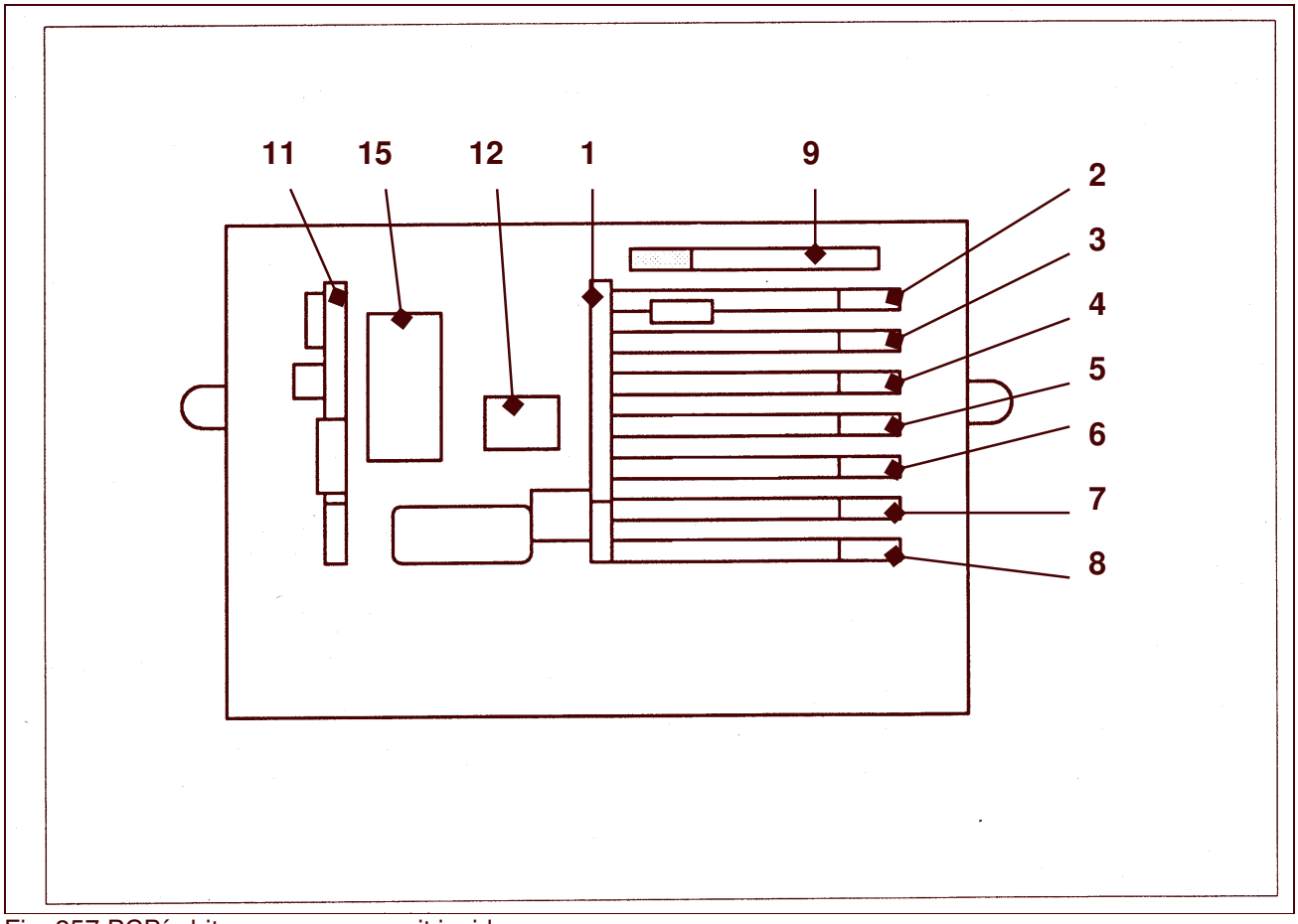


Fig. 257 PCB´s bit map memory unit inside

3.5.3 Display unit

Nr.	PCB designation	Function
1	WM 10	Main board
2	WM 20	Power supply
3	WM 30	Tube socket board
4	WM 50	Motorized deflection coil
5	WM 60	Rotation controller

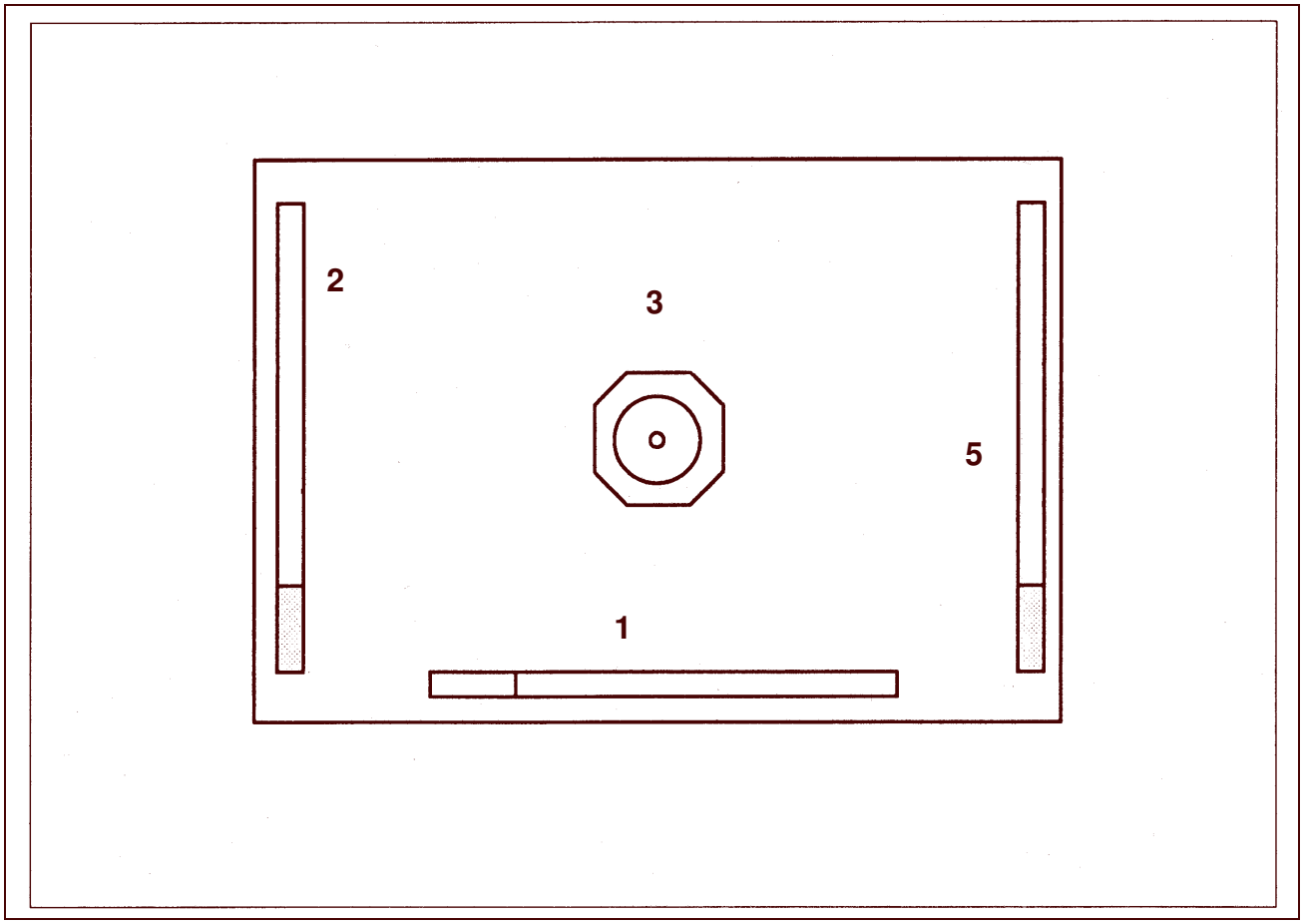
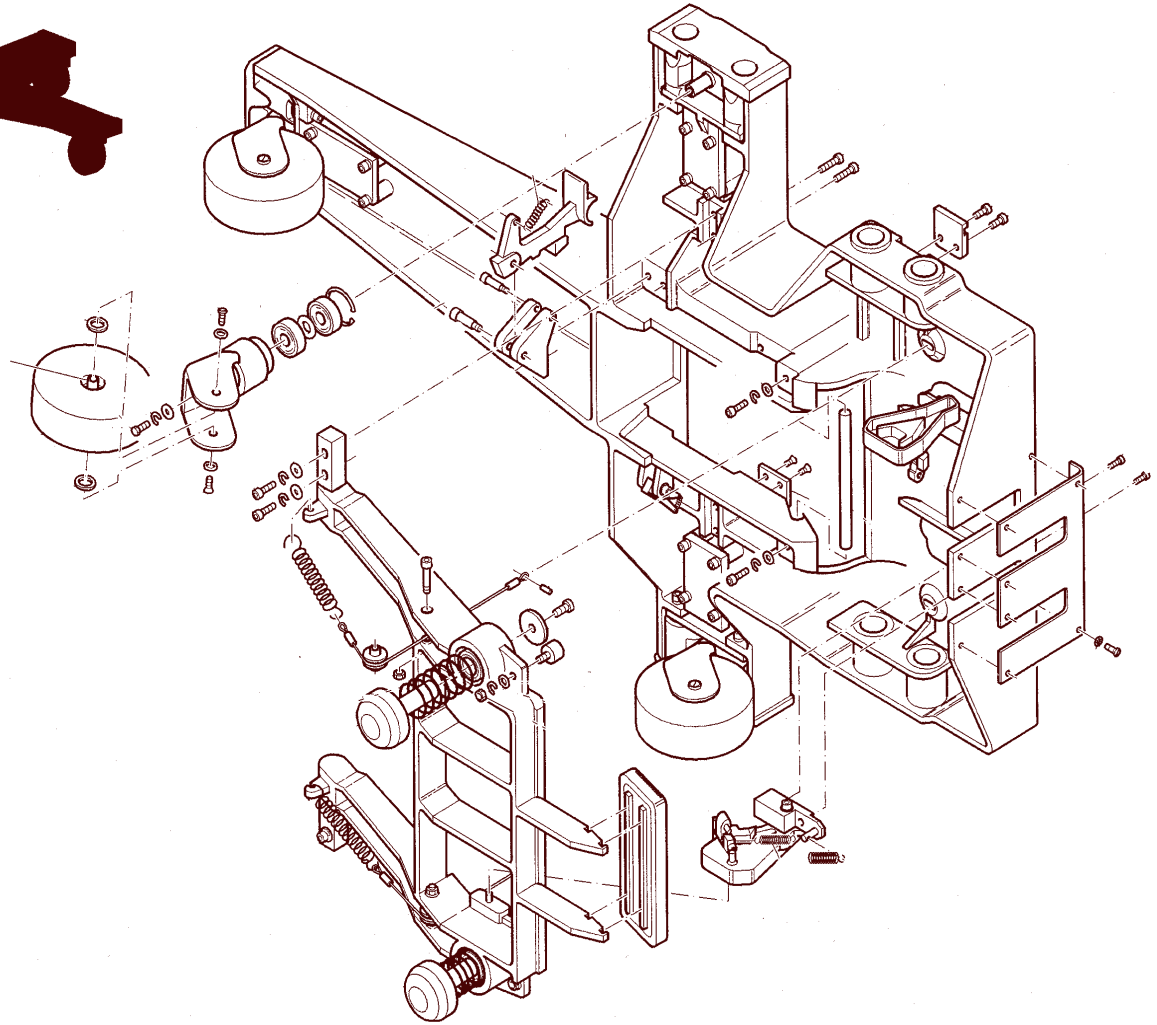


Fig. 258 PCB´s display unit

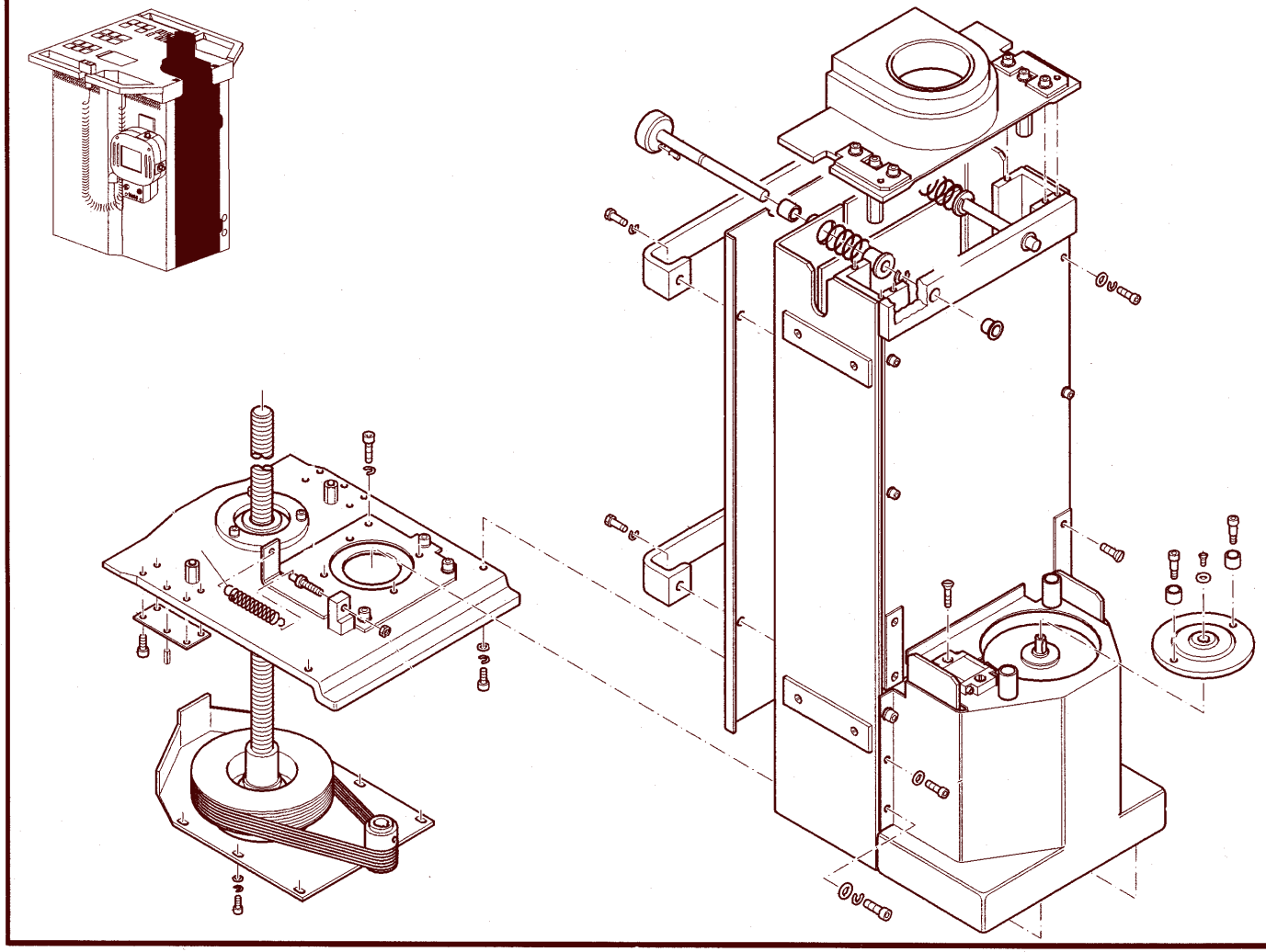
Part 4

Appendices

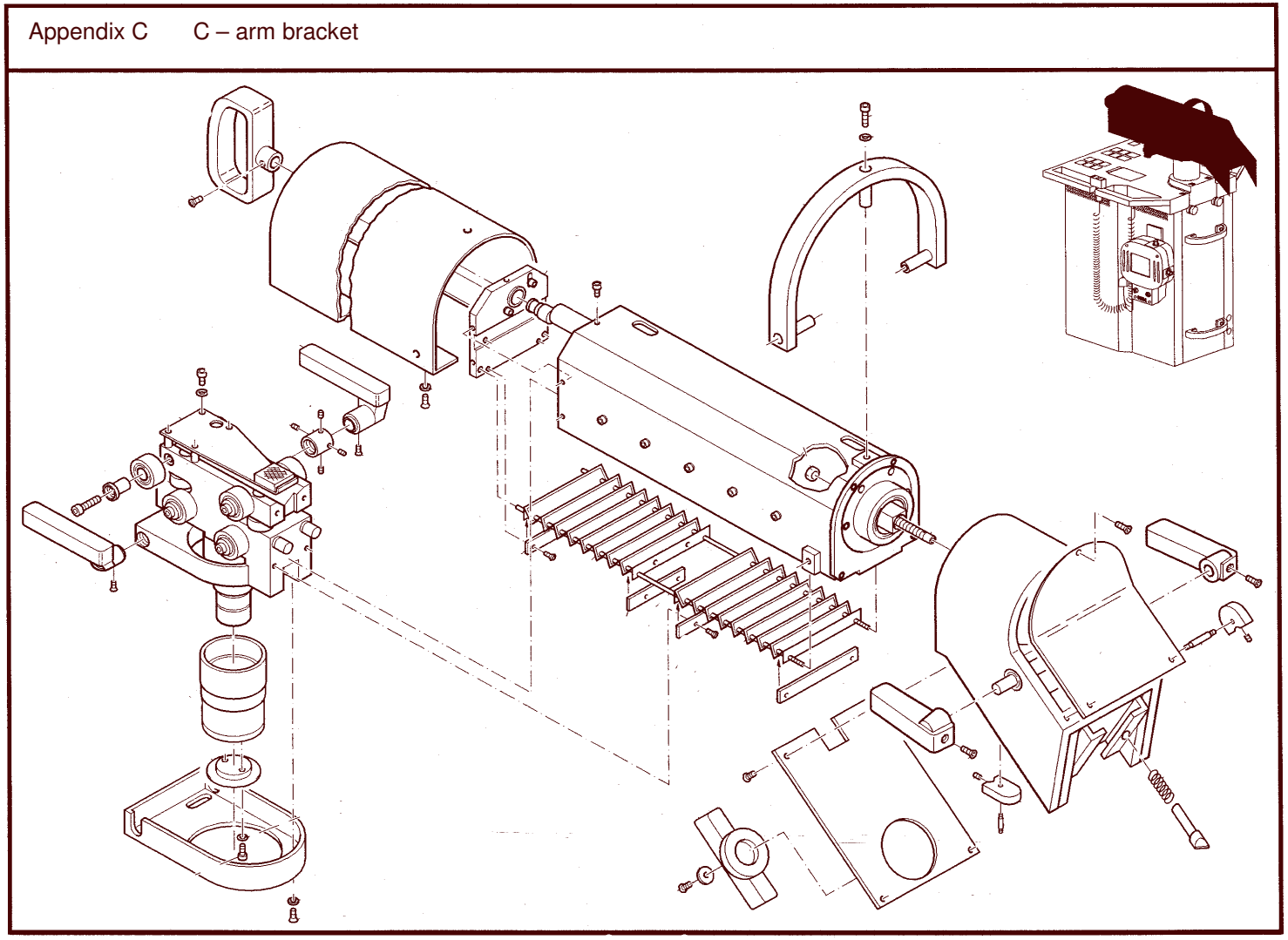
Appendix A Chassis



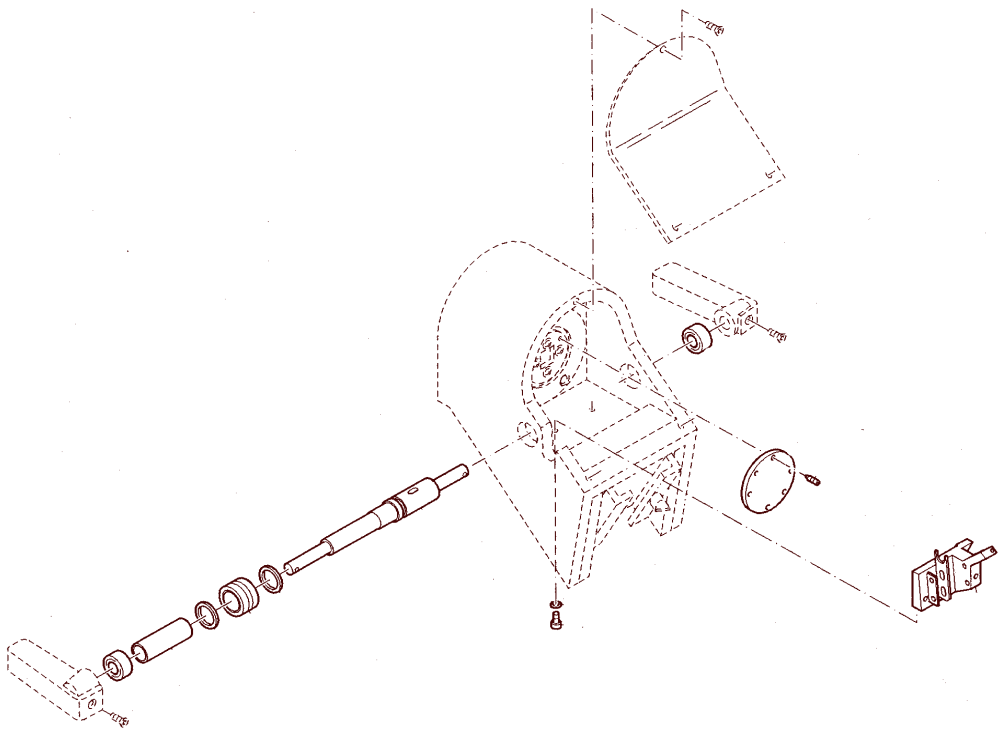
Appendix B Stroke column



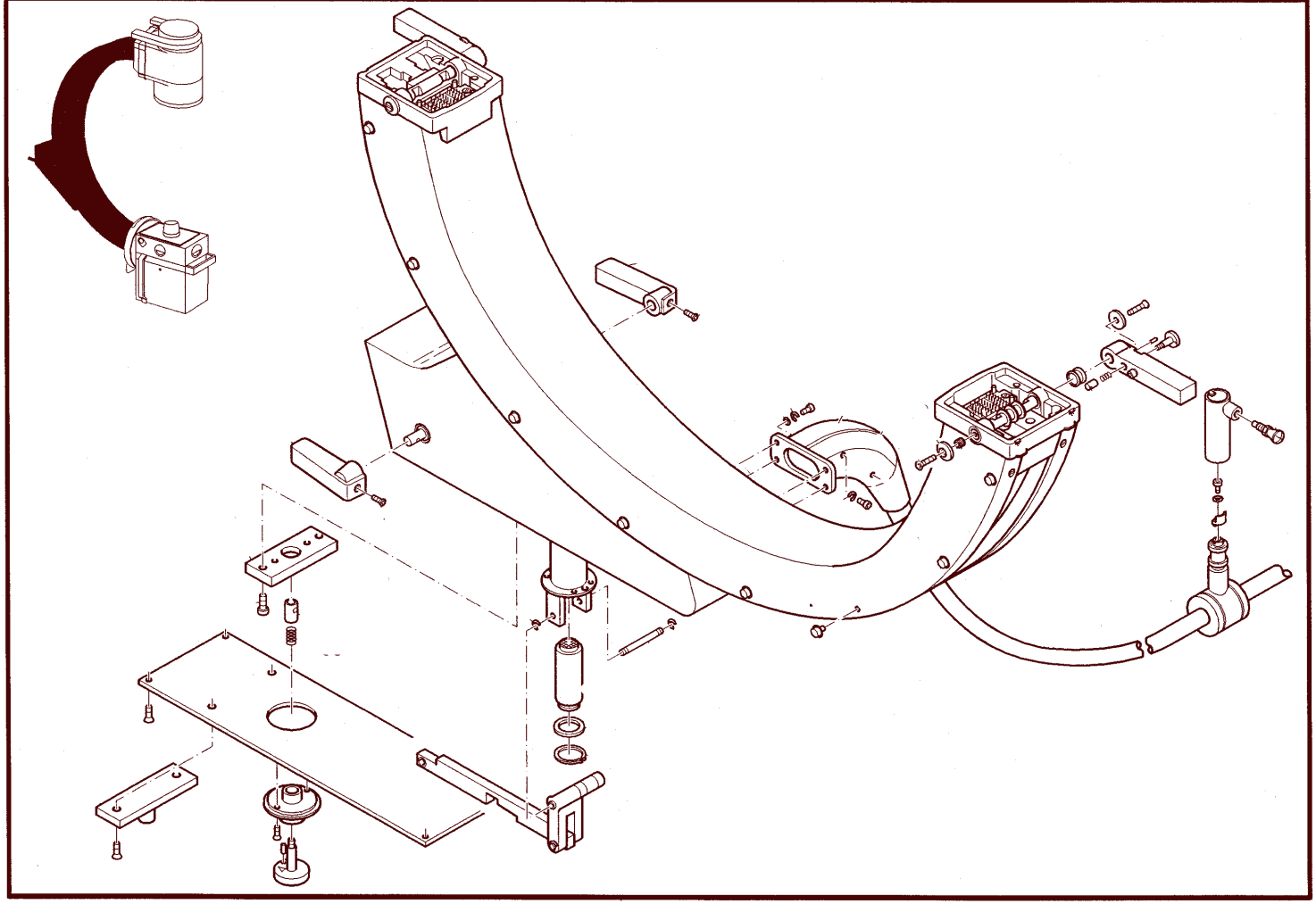
Appendix C C – arm bracket



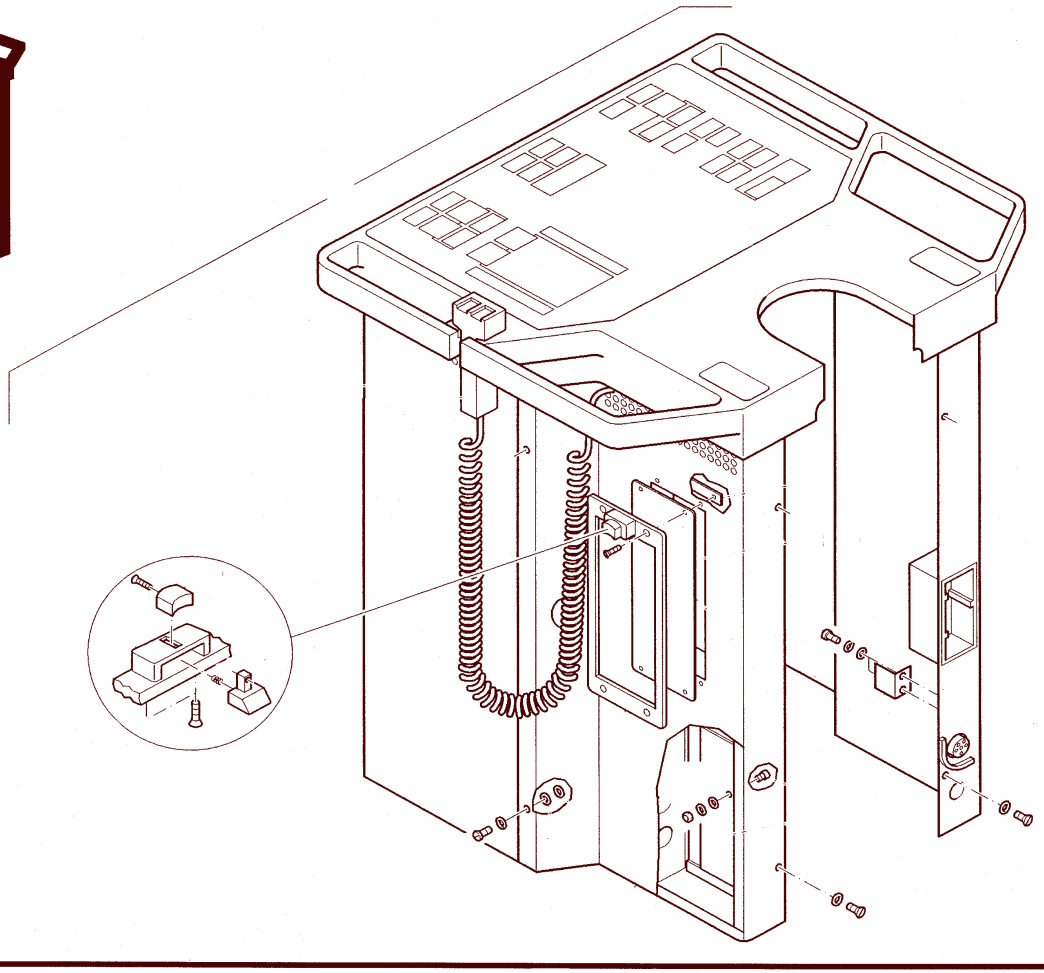
Appendix D C – arm bracket detail



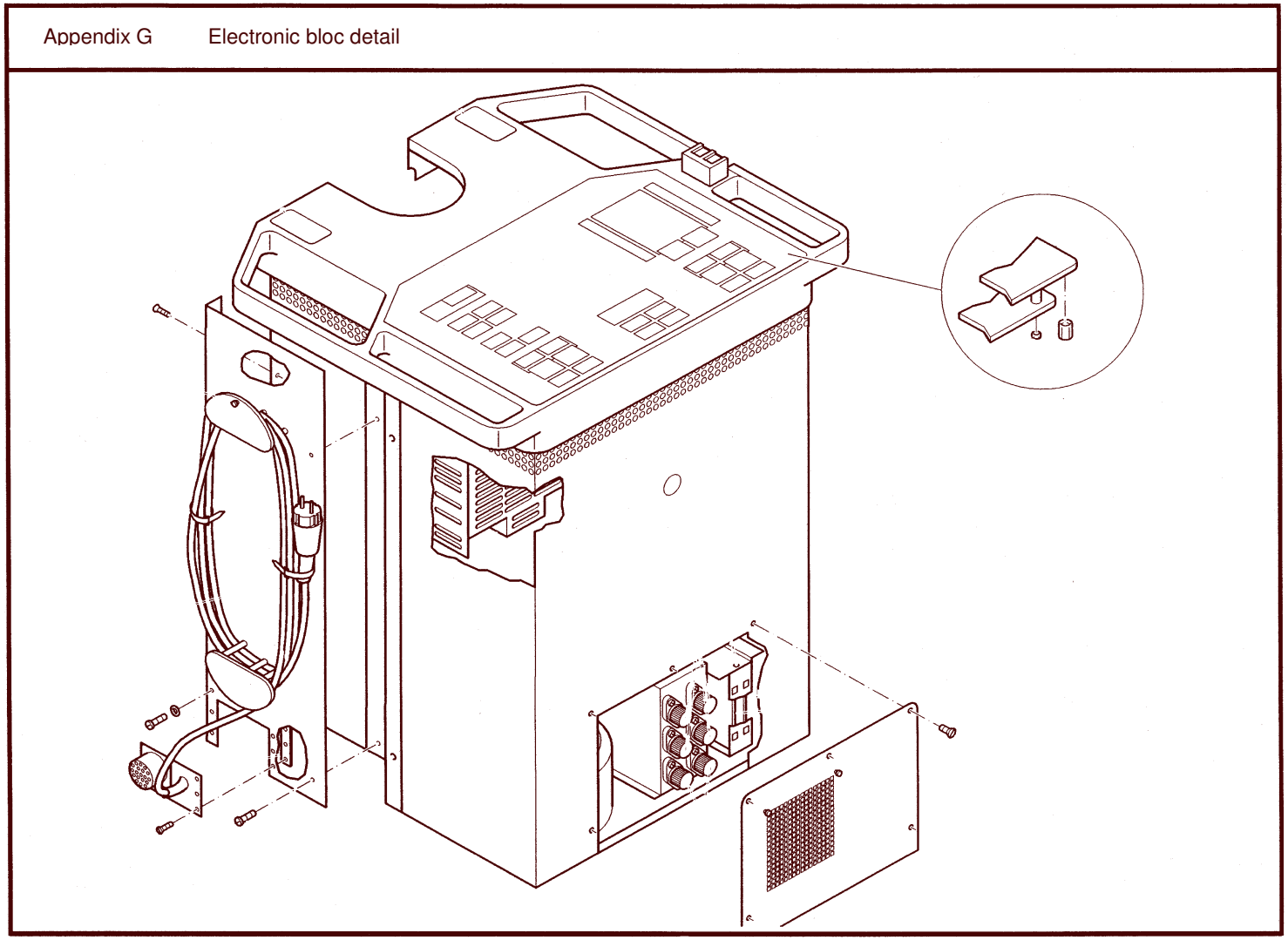
Appendix E C – arm



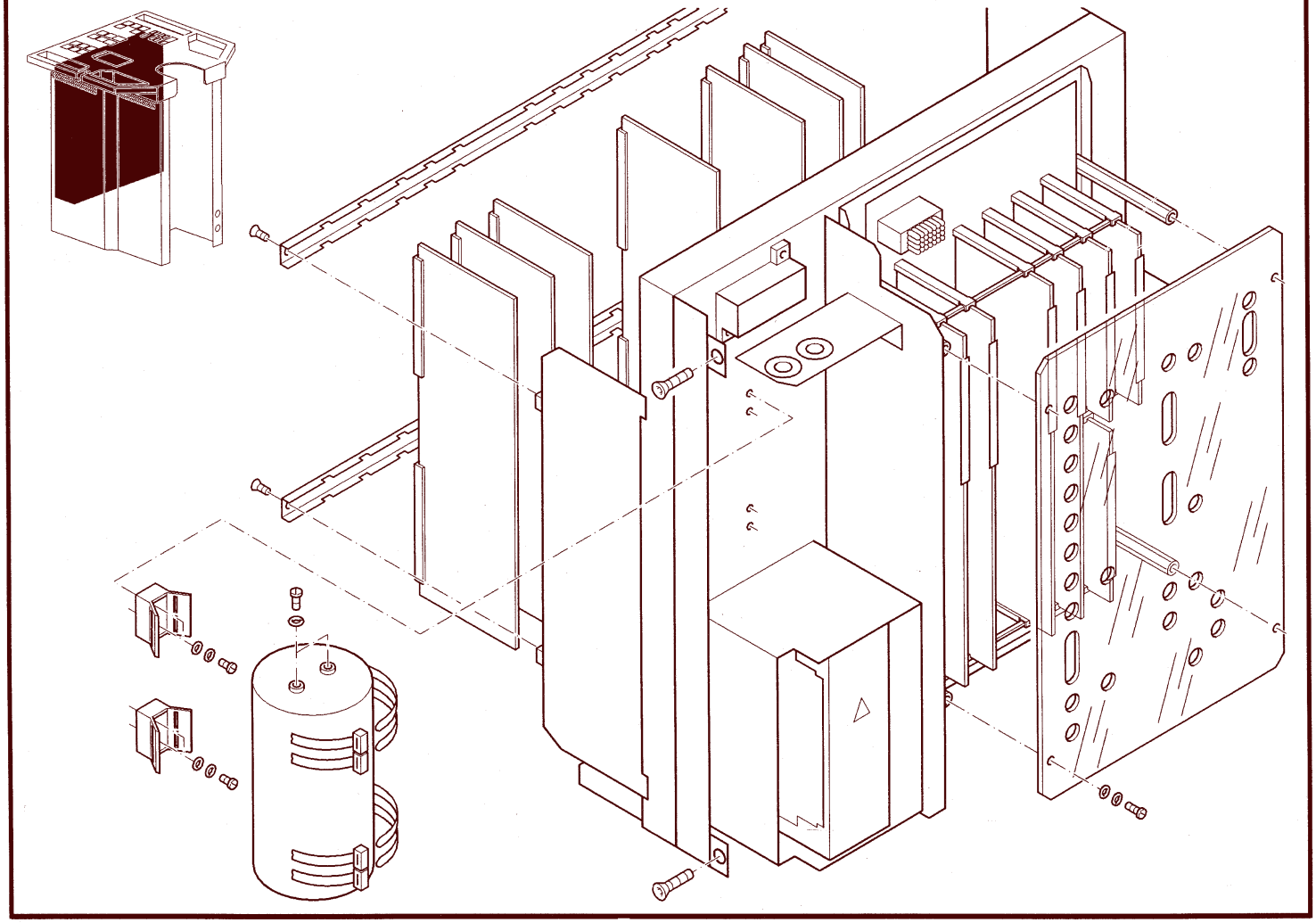
Appendix F Electronic bloc detail



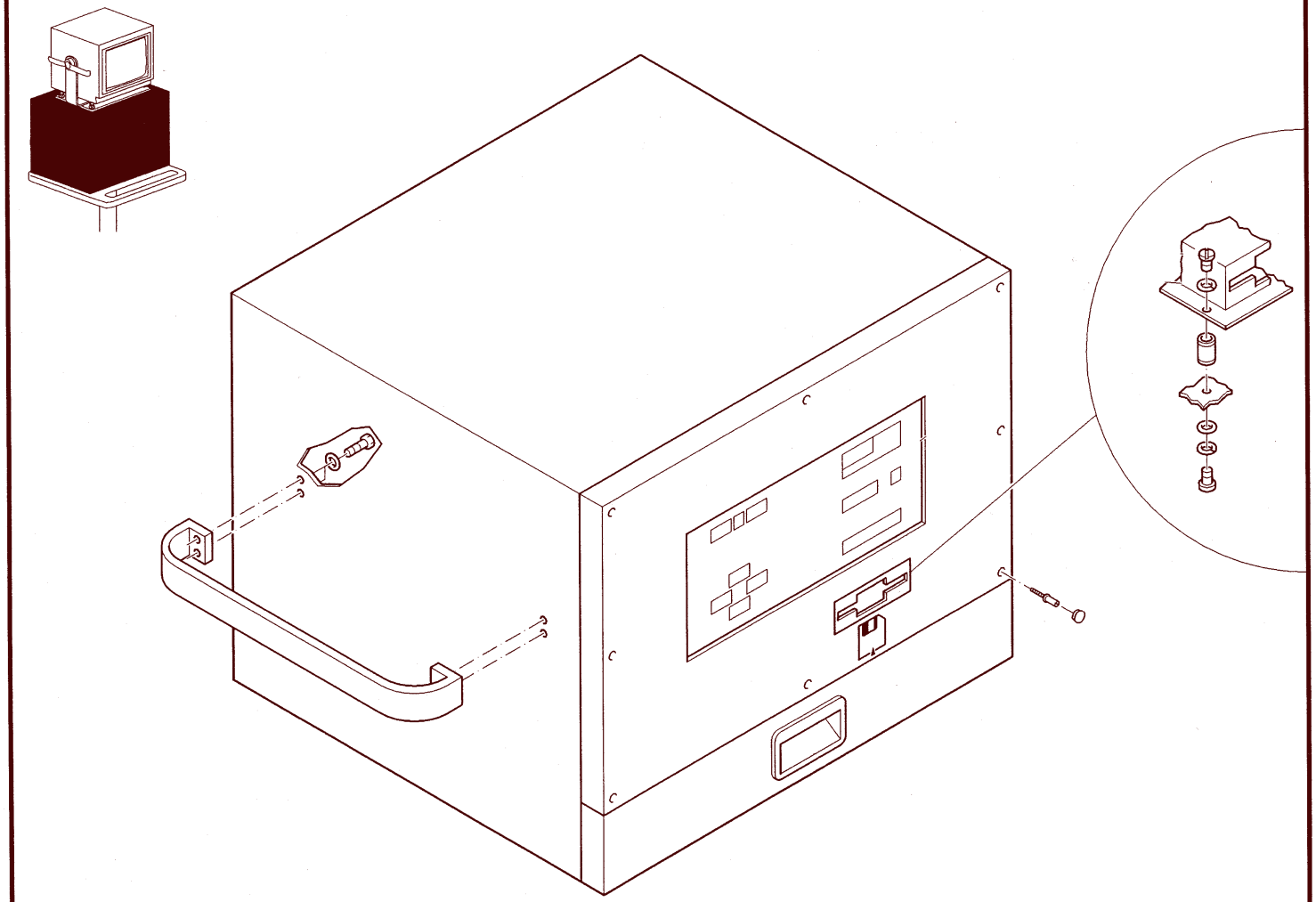
Appendix G Electronic bloc detail



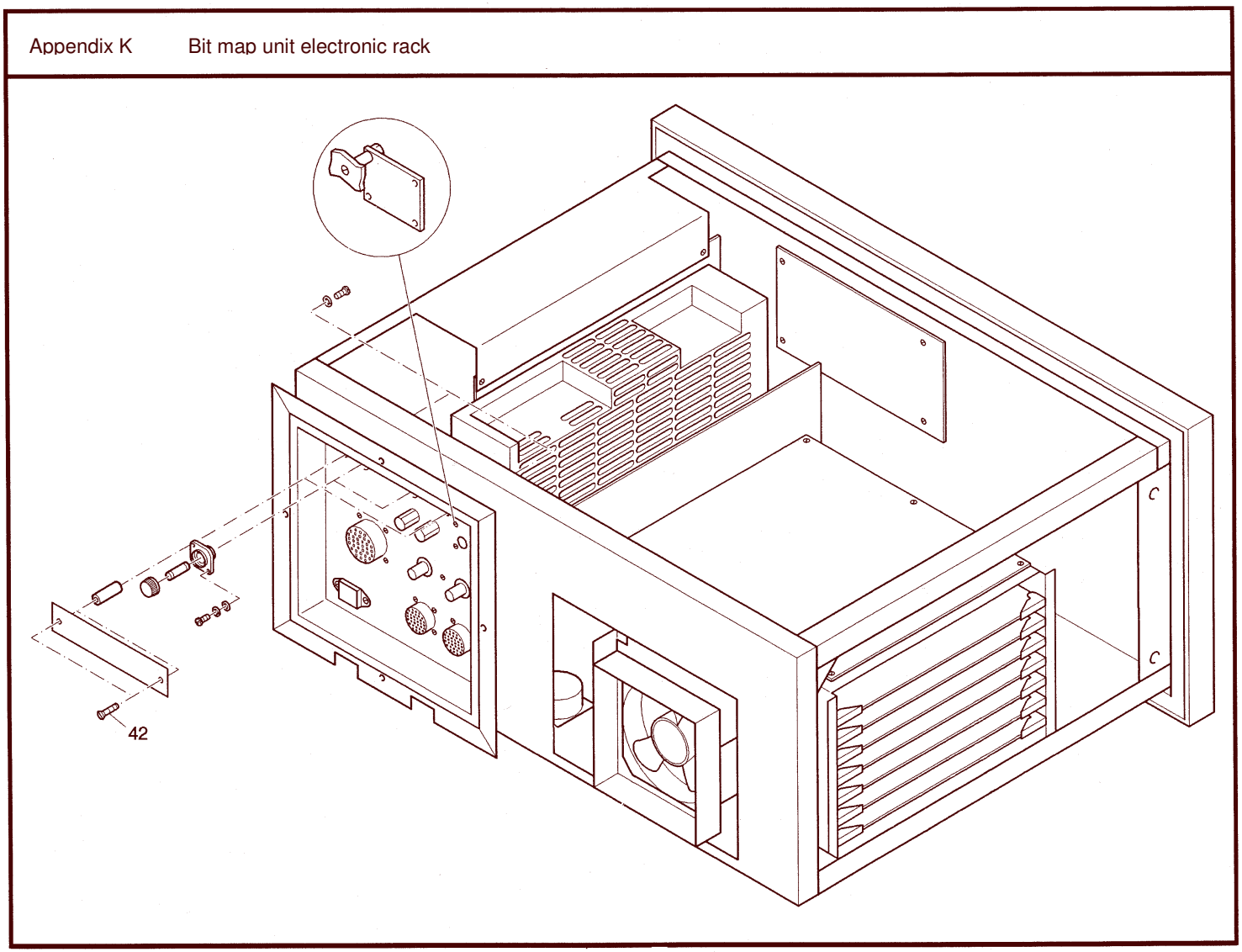
Appendix H Electronic bloc rack



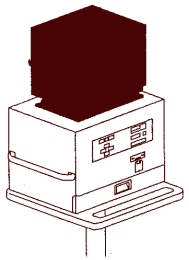
Appendix I Bit map unit detail

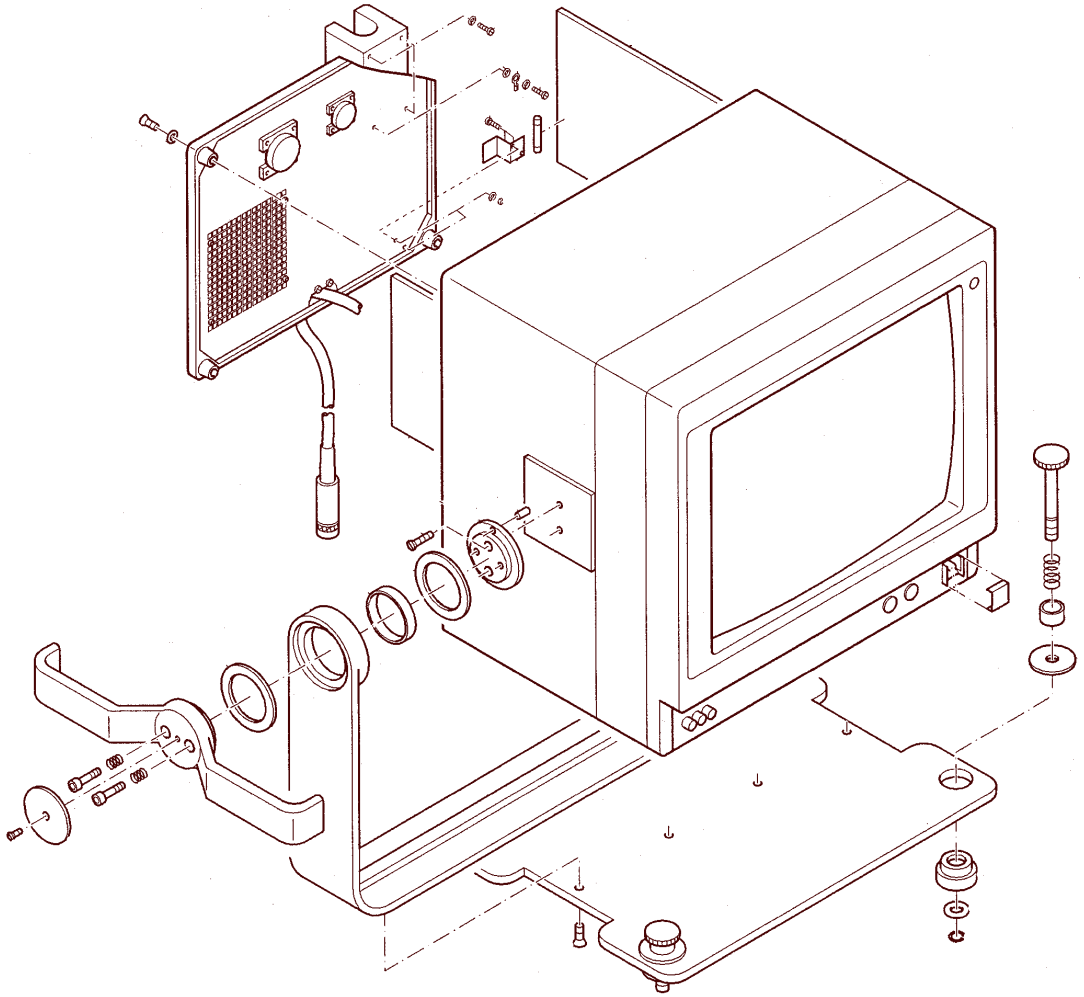


Appendix K Bit map unit electronic rack

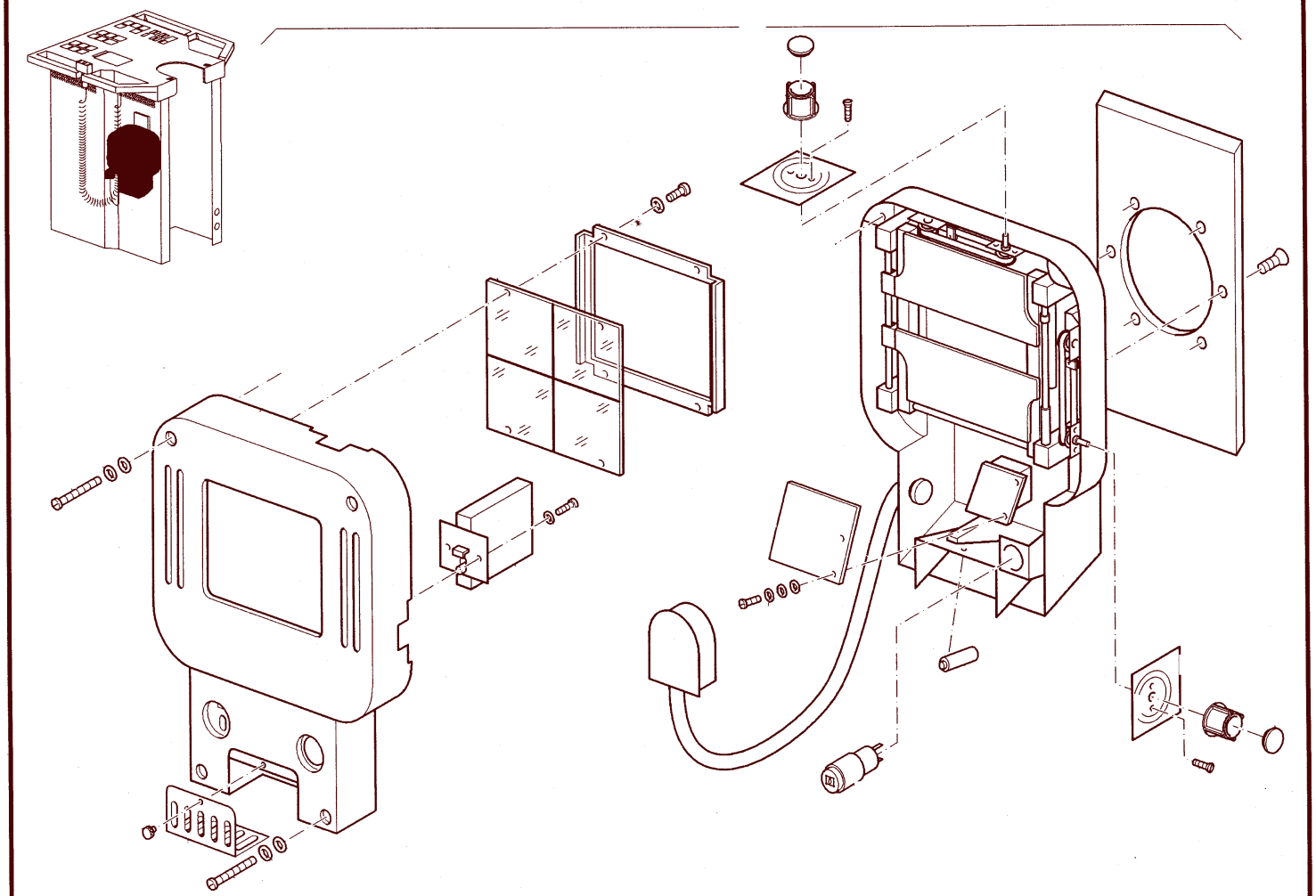


Appendix L Display unit





Appendix M Collimator



CAUTION

Equipment is an X - ray source in the sense of the X - ray regulations

No Admission X – Ray's